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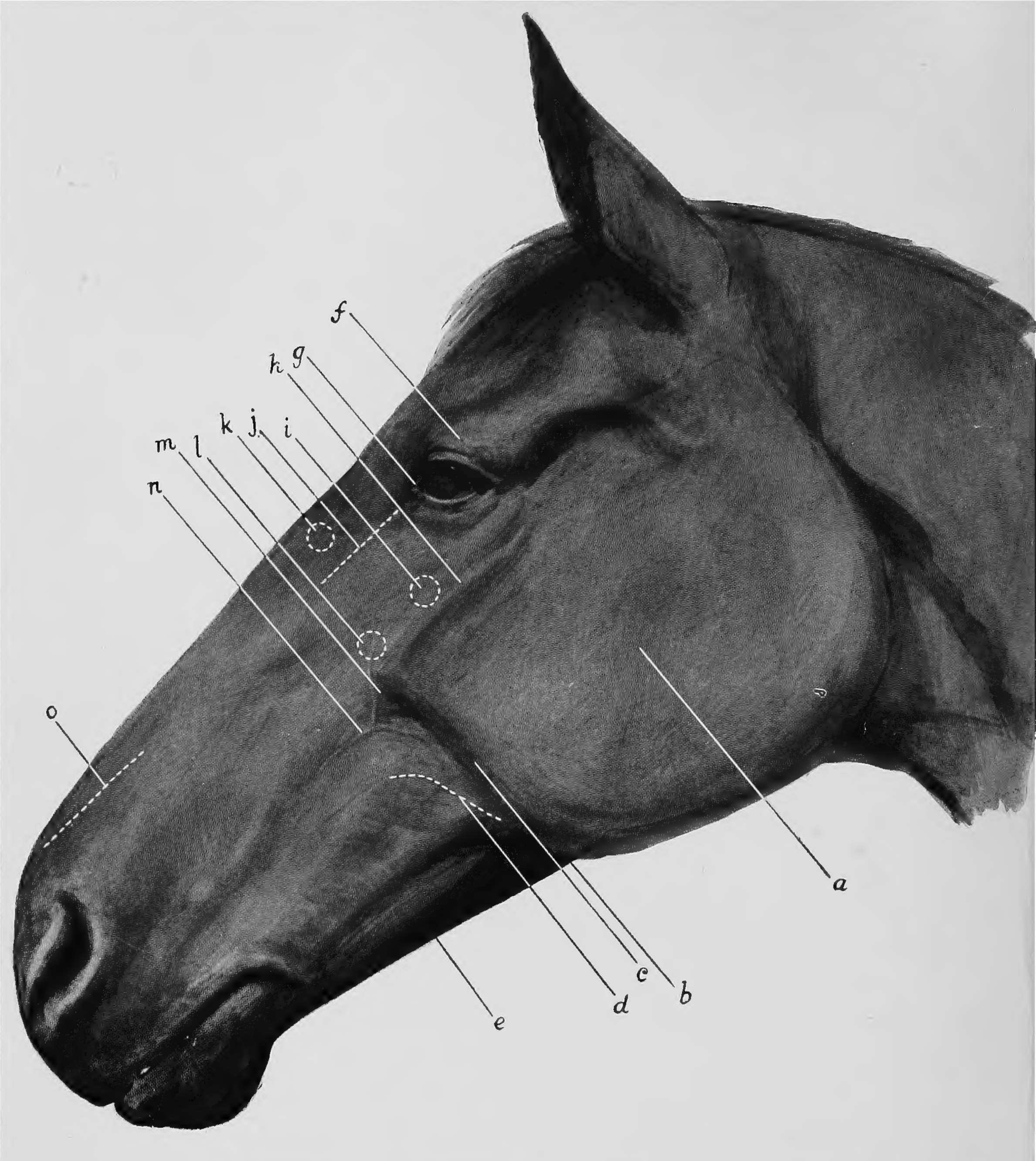

PLATE 2.—SIDE VIEW.

a, Masseter muscle; *c*, lower border of masseter muscle; *b*, point at which the submaxillary vessels and Stenson's duct cross posterior border of horizontal ramus of lower jaw; *d*, position of Stenson's duct on the face; *e*, posterior border of horizontal ramus; *f*, supraorbital process of the frontal bone; *g*, nasal canthus of eye; *h*, zygomatic ridge; *i*, position of trephine-opening into superior maxillary sinus in empyæma; *j*, dotted line indicating position of the osseous lachrymal canal; *k*, position of trephine-opening into the lower extremity of the frontal sinus; *l*, position of trephine-opening into the inferior maxillary sinus in empyæma; *m*, lower extremity of zygomatic ridge; *n*, nasal origin of the submaxillary vein; *o*, line indicating the position of the side of the nasal peak.

ENCYCLOPAEDIA
OF
VETERINARY MEDICINE SURGERY & OBSTETRICS

EDITED BY

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VETERINARY SURGERY

INFLAMMATION

Its Nature, Causes, Effects, and General Treatment

The Nature of Inflammation.—The study of inflammation is a task of considerable magnitude. To many uninstructed lay minds the term "inflammation" appears to act as an anodyne satisfying all inquiries as to the cause of an illness or even a death, but doing so only by numbing the mind with the mystery enshrouding the term. To the student of disease, whether in man or animals, the term "inflammation" in its broadest sense comprehends the great part of pathology, medical and surgical. In this article an attempt is made to give as clear an understanding as possible of the nature of the inflammation processes, their causes, the results which follow or are produced by them, and the general medical or surgical treatment necessary. Such an understanding of inflammatory processes in general is essential to, and must precede, an understanding of the nature of the almost innumerable diseased conditions whose names have the suffix *itis* (signifying *inflammation of*), such as *arthritis* or *laryngitis*, as well as many others, such as *pneumonia*, to which this distinctive appellation is not commonly appended. Much repetition in the way of descriptions of the fundamental phenomena of inflammation will thus be avoided throughout this volume, and in articles treating of inflammation of the various organs and tissues of the body only specially characteristic or peculiar phenomena distinctive for that organ or tissue will require to be described in detail.

The study of inflammation is an old one and many definitions have been proposed as more and more light has been thrown on the phenomena observed. Celsus drew attention to what are still called the cardinal symptoms of inflammation, *calor*, *dolor*, *tumor*, *rubor*, and to these later writers have added a fifth, *functio læsa*, *i.e.* impairment of function. But the observation of these characteristic features in an inflamed area gave no clue to the process, and John Hunter, the celebrated English surgeon, went much further when he defined inflammation as "a process set up by injury and tending to counteraction of the same." Later still Cohnheim studied the vascular changes occurring in an injured part by observing the web of a frog's foot under the microscope. On applying to this delicate, highly vascular, and translucent membrane some irritant such as a drop of an acid certain changes in the flow of blood through the vessels are soon apparent, and Cohnheim was the first to lay stress on these as characteristic features of inflammation. But in less vascular areas these phenomena are less marked, and if the injury be of a milder but more prolonged type the chief changes are of the nature of connective tissue overgrowth. With a wider understanding of the whole series of observed changes, Burdon Sanderson of Oxford defined inflammation as "the succession of changes occurring in a part as the result of injury insufficient to kill the part." Thus we can at the very outset of our study fasten on to the conception that inflammation is not made up of a series of harmful events submitted to passively by a part of the body subjected to an injury, but is rather a struggle or reaction tending to counteract the local effects of that injury. Two further definitions, terse but comprehensive, due, the former to Adami, the latter to Grawitz, may be given, namely, that inflammation is "the local attempt at repair of injury" or "the reaction of irritated and damaged tissues which still retain vitality."

Metchnikoff, in his exhaustive and illuminating study of the functions of leucocytes and of phagocytosis, has shown how important these cells are in inflammation, responding as they do with extraordinary sensitiveness to injury. In this particular the leucocytes are very similar to such a simple unicellular organism as an *amœba*. It may be well, therefore, to consider this simplest possible case of inflammation (*i.e.* reaction to an injury insufficient to kill) in a unicellular organism.

To such a simple little mass of protoplasm surrounding a nucleus, living in a fluid medium, such as pond water, the injury will usually be of a chemical nature. Some substance inimical to the amœba is in solution in the water and at once a reaction begins. The cell which was before putting out *pseudopodia* to envelop any food particles floating within its range, now draws them in and becomes quiescent. It may die as a result of the poison, but by hypothesis such a degree of injury is not contemplated. If it survive it will shortly begin to show signs of renewed activity, moving about, extending its *pseudopodia*, and surrounding food particles as before. Its recognition of food particles must really be in the nature of a chemical reaction, the food exuding or exhaling some substance into the water which stimulates the amœba to ingest it. This sensibility to chemical agents is possessed not only by unicellular animals but by plant cells and by cells in the bodies of the higher animals, and Pfeiffer applied the name *chemiotaxis* to this property of cells. It is developed in the body to a remarkable degree as a defence mechanism, as has been shown especially by Metchnikoff. But to continue our observations. Sometimes the amœba may have to wage war against other small organisms, and here again the intelligence will be by means of a chemical stimulus indicating the presence of the enemy and suggesting one of two courses of action. Either the amœba may advance, and proceed to engulf, digest, and destroy the foreign organism, or if the enemy be too powerful or virulent the amœba may retreat, withdrawing its *pseudopodia*, and moving as far away as the medium will allow so long as the presence of the enemy is felt.

Put briefly, our unicellular organism reacts to injury in one of three ways. These are :

(1) By *adaptation*, in which the organism becomes habituated to, or tolerant of, the injurious substance.

(2) By *chemiotaxis*, that is, the chemical attraction (positive chemiotaxis) or repulsion (negative chemiotaxis) of the organism by the injurious substance.

(3) By *phagocytosis*, where the organism ingests and destroys the injurious substance or particle.

The adaptation of a cell to an initially distasteful substance shows itself by a change from negative to positive chemiotaxis.

If the investigation of inflammation be carried into the range of slightly higher organisms such as the *metazoa*, in which we have the earliest development of a *mesoderm*, other interesting phenomena can be observed. The body, covered outwardly by an *ectoderm* and lined internally by an *entoderm*, has between these layers a body cavity or *cœlom* in which, in the lowest types, there is a *mesoderm* which consists simply of wandering cells. With an injury of such a nature as the entrance of an invading foreign organism into the body, the mesodermal cells at once react to the stimulus, and, in the case of a successful reaction, proceed to crowd round and envelop the invader. The individual mesodermal cells fuse to form a multinucleated mass called a *plasmodium*, and the foreign body is killed and digested, or simply encapsulated and made harmless. This process of crowding round an invading organism is very similar to the formation of *giant cells* in the higher animals, as we shall see.

But these simple conditions in unicellular and little differentiated organisms are subject to great modifications in the body of one of the higher animals. In such an animal, as in man, there is a closed system of blood-vessels ramifying in all directions and carrying a fluid, the blood, which is made up of the *liquor sanguinis* or plasma, and the blood cells of two kinds, the white and red corpuscles. Propelled by the heart, the blood circulates through the arteries, arterioles, and capillaries practically to all parts of the body, and is returned for the most part by the venules and veins to the heart. Arteries and veins have, comparatively speaking, thick impervious walls through which neither plasma nor cells can easily escape, but the capillaries have walls made up of endothelial cells of only one layer, and both liquid and cells can under certain circumstances leave the vessels and escape into the tissues through the endothelial layer. One of the most important functions of the blood is to convey nutriment, taken up from intestines and lungs, to the cells of all the tissues, and to remove waste products from the tissues to the lungs, kidneys, and other excretory organs. In order to supply individual cells some of the plasma laden with nutriment normally escapes from the capillaries, becomes extravascular, and bathes the cells. Exhausted of its supplies the fluid, now called lymph, is taken up by another set of thin-walled vessels, the lymphatics, and by them carried to the main lymph channel, called the thoracic duct, which empties its lymph into the great veins near the heart.

Such are the chief " lines of communication," to use a military phrase, in the body, and the possession of this closed vascular system and subsidiary lymphatic drainage system altogether modifies the process of inflammation. Receiving an injury in any tissue or organ, the body is possessed of interior lines of communication, and is thus enabled to send reinforcements of defending cells and supplies for the repair of the damaged structures. Further, the casualties resulting from the injury, broken down or dead cells, can be removed along one or other of the two routes. Thus the blood-vessels in an inflamed area are very intimately concerned with the reaction which follows the injury, and it was the observation of the remarkable series of changes occurring so constantly in the blood-vessels of an inflamed area which led Cohnheim to emphasize the *vascular phenomena* almost to the exclusion of all else. Not all tissues, however, are equally vascular, indeed in some there are very few blood-vessels, and here other factors come into play. Again, not all injuries causing inflammation call for the same reparative or defensive measures. It may be well to consider briefly, therefore, what the causes of inflammation are, in order that the appropriate reaction may be understood.

Causes of Inflammation.—Inflammation may be caused by a great variety of injuries, but most of them can be included in one or other of the following: (1) mechanical; (2) thermal; (3) chemical; (4) toxic.

Mechanical injury is frequently seen giving rise to inflammation, as in the case of friction by harness producing inflammation of the skin; stretching or spraining in galloping or jumping causing inflammation of a tendon; a blow or fall bringing about fracture of a bone with all the phenomena of inflammation; or a wound by means of any sharp instrument with a reaction in the adjacent tissues leading to healing of the wound.

Thermal injury, as by burns or scalds, or the injury by an electric spark or by lightning stroke, at once sets up an inflammatory reaction with all the well-marked signs.

Chemical injuries, by means of caustic substances such as quicklime or strong acids or caustic alkalies, are very obvious and well known to all. Less well known are the inflammatory reactions caused by chemical irritants within the body acting on tissues with which they come in contact. Cantharides given internally, or absorbed from a too-plentiful application to the skin, is excreted through the kidneys and urinary tract, and gives rise to acute inflammation in the kidneys and bladder. Alcohol passing through the liver in frequent small doses is a chemical irritant, and results in a chronic inflammatory reaction in that organ. A fairly common weed—*Senecio Jacobœa* or "Ragwort"—eaten by cattle on rough pasture for several weeks or months produces a very similar reaction in the liver, in much the same way and with equally serious results.

There are very great differences between the acute reaction with great pain, heat, redness, and destruction of tissue caused by the application of a strong mineral acid to the skin, and the chronic reaction with a painless and slow development of fibrous tissue crushing out the degenerated liver cells brought about by the frequent use of alcohol. Both reactions are, however, examples of chemical injury causing inflammation, and between these two extremes all gradations of injury and reaction may be seen.

Toxic injury is possibly the commonest type of injury producing inflammation. It is brought about by the presence of *bacteria* in the tissues as a result of the infection of a wound or bruise, or as part of a general infectious disease. The bacteria, having been introduced into a wound or having invaded a tissue from the blood stream, proceed to multiply and to obtain nutriment from the tissues. Growing and multiplying in this way they produce toxic substances or *toxins,* as excretory products of their metabolism or as the result of active secretion, and these toxins straight away call forth a reaction on the part of the tissue infected—in other words, they produce inflammation. Thus we may look upon toxic injury by bacteria as a special form of chemical injury. Either as a result of the original wounding or as a consequence of the toxic action of the infecting bacteria, a portion of the tissue attacked may die. The dead tissue is probably already invaded by the bacteria, or it is disintegrating and dissolving under the ferment action of its own juices. In the former case the bacteria in the dead mass will continue to produce toxins which will irritate and injure the adjacent living tissue, whilst in the latter the breakdown products themselves are often highly injurious and irritant to living cells. Thus a piece of dead tissue will, whilst still embedded in a living tissue, continue to act as an irritant, producing chemical injury and inflammation.

Injury by *toxins* brings about a reaction in much the same way as other chemical irritants, but there is an extremely important difference. So long as the bacteria producing the toxins remain alive in the tissue so long will they go on multiplying, and the supply of toxin will be kept up, so that whilst a mechanical injury such as a blow is inflicted and then ceases after a longer or shorter time, a bacterial or toxic injury goes on indefinitely, and with increasing severity, unless the reactive processes are able to subdue and expel the invading organisms.

Reactive Resources of the Body.—From a consideration of the foregoing statement of the causes of inflammation it is possible to realize the demands put upon the defensive and ameliorative forces of the body which has been injured at some point. If the injury is of a very mild type, but continuing over a long period of many days or weeks, then the tissue attacked will probably be able to supply from among its own cells those that are necessary for successful reaction. Such a reaction is seen in the formation of a fibrous tissue capsule round a parasite, such as a hydatid growing in liver or lung. On the other hand, with a suddenly occurring injury of a severe character, the resources of the part are inadequate, and must be reinforced rapidly. Here the blood-vessels, the interior lines of communication, are of inestimable value, and signs of effort on their part are very evident. It was these signs which Cohnheim observed in his study and described as the *vascular phenomena* of inflammation.

Vascular Phenomena.—To study these changes a frog's web or a frog's tongue may be used.[1] In the first few minutes following injury there is a local contraction of the arterioles, and so a temporary blanching of the part. This is speedily followed by a progressive arterial dilatation, bringing about a greatly-increased flow of blood through the area. This distension spreads down to the smallest vessels, and capillaries previously invisible are now easily detected. Such a distension of the vessels of the part may be seen within half an hour of the injury in the frog.

Meantime there is a gradual slowing of the current of the blood stream. On first sight the current was so swift that individual cells could scarcely be seen, but there was a blurred stream of red cells rushing on in the centre of the vessel, and a clearer zone of plasma on each side. Now the current is slower, the axial stream has broadened out, and individual cells can now be distinguished. The red and white cells can be differentiated, and it is seen that the white cells (leucocytes) are tending more and more to the outer or peripheral part of the blood stream.

By the time this stage has been reached in the blood stream of an inflamed area, the part itself is beginning to appear swollen. Experimentally, by putting a fine tube into one of the main lymphatic vessels it can be shown that corresponding with this stage there is a greatly increased outflow of lymph from the blood-vessels into the tissues as compared with the normal. This lymph drips out from the tube or cannula much more rapidly than from a normal uninflamed area.

But to return to the blood-vessels. The white cells or leucocytes in the outer zone of the blood stream are now seen to be increasingly numerous, and they are beginning to adhere momentarily to the side of the vessel, just as twigs floating along in a slow stream catch against the bank. The current becomes still slower and eventually numbers of leucocytes adhere to the side of the vessel and the current comes almost if not quite to a standstill. This condition of *stasis* affords an opportunity to watch some of these adherent leucocytes. Not only are the leucocytes very numerous inside the capillary, but a number may be seen *outside* the vessel in the neighbouring tissues, and in a suitable preparation the actual passage of these white cells through the vessel-wall may be observed. The adherent cell puts out a process which penetrates between adjacent endothelial cells of the capillary wall, and the process grows larger and larger on the outside till all the cell has squeezed through and is free to wander outside the vessel in the inflamed tissue. This process is called *migration* or *diapedesis.*

The leucocytes or white cells of the blood are not all of one type; there are several varieties. The chief types actually concerned in inflammation are: (1) the *polymorphonuclear* leucocytes, fairly large cells with a bi- or tri-lobed nucleus, and a fairly wide ring of cytoplasm round it; (2) the *lymphocytes,* small cells with a monolobular nucleus nearly occupying the whole cell and leaving a very narrow encircling ring of cytoplasm; (3) large *mononuclear* leucocytes, with a round or oval rather faintly-staining nucleus, and a considerable ring of cytoplasm; and (4) the *eosinophils,* fairly large cells whose nucleus is obscured by granules in the cytoplasm, which granules stain readily with acid stains such as eosin.

In an acute inflammation it is especially the *polymorphonuclear* cells which migrate, but in special conditions and in more chronic cases lymphocytes, large mononuclears, and eosinophils may all pass through the vessel-wall. Diapedesis does not occur in arteries, but only in thin-walled vessels such as capillaries and small veins. The escaped leucocytes may wander a considerable distance among the tissue elements from the place where they escaped. In all severe inflammations some red corpuscles as well as leucocytes escape, but probably this is purely mechanical from serious injury to the vessel-wall allowing of leakage.

The fluid which escapes from the vessels constitutes what is called the *inflammatory exudate.* It saturates the tissues and solid organs, distending their lymph spaces, and so bringing about the characteristic swelling in the inflamed area. In the case of an inflamed membrane, such as the skin, or pleura, or peritoneum, the exudate escapes from the free surface and accumulates in any cavity bounded by the membrane. Thus, in cases of pleurisy the fluid in the chest cavity is an inflammatory exudate which has transfused from the damaged pleura. Such an inflammatory exudate is usually more or less turbid from its contained leucocytes, and sufficiently rich in fibrin for a thinner or thicker layer of coagulated whitish-yellow lymph to be deposited on the free surface, and for stringy shreds or flocculi of lymph to float in the fluid.

To find an explanation for these various phenomena it is necessary to realize the extreme sensibility of the endothelial cells of which the capillary vessel-walls are built. The injury, whatever its nature, has caused damage to these sensitive cells, and so the capillary tube instead of being almost frictionless now opposes the flow of blood.

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[1] The backwardly directed tongue of the frog may be drawn from the mouth and stretched over the stage of the microscope. Another method is to examine the mesentery of a rabbit.

Thus the current is made slower, and the leucocytes have got something to adhere to. The dilatation of the vessels of the part is largely under the control of the (vaso-motor) nervous system. The accumulation and migration of the leucocytes is not merely a mechanical process, but quite definitely a vital one. Possessing the characteristic property of *chemiotaxis*, the white cells of the blood scent out the damaged cells of the injured part, and are particularly attracted by certain common *bacteria* often present in wounds. The leucocytes are amœboid and can protrude *pseudopodia*, the distended vessel-wall is stretched, and possibly the cement substance uniting the adjacent endothelial cells is less resistant than normal, and so the active leucocytes first adhere to and then penetrate the capillary wall to seek out the invading micro-organisms in the tissues outside. Thus the richness of an inflammatory exudate in cells depends on the degree of attraction for leucocytes outside the vessels. In cases where suppuration or pus formation occurs as a part of inflammation it is because the leucocytes show great positive chemiotaxis towards the chemical products of the causal bacteria. On the other hand, some highly virulent bacteria secrete products which exert great repelling effects on the leucocytes, and in such cases any inflammatory exudate is poor in cells. In still other cases, although there is no marked repulsion of leucocytes there is no active chemiotaxis on their part for the bacterial toxins or other products of the injury, and so again the inflammatory exudate is free from cells and thin.

The exudate itself may be extruded from the vessels to some extent mechanically as a result of the congestion and the stretched capillary walls. Much more reasonable is the view that just as Heidenhain supposes the endothelial cells of the vessel-walls to *secrete* the ordinary lymph required for the nutrition of the normal tissue of the part, so in inflammation the endothelial cells secrete an excess of fluid for the purposes of repair.

The explanation of the cardinal symptoms follows naturally from what has gone before. The swelling—*tumor*—has already been explained as due to the excess of fluid or exudate. The redness—*rubor*—and the heat—*calor*—are both due to the congestion and distension of the blood-vessels of the area. The pain—*dolor*—is in large measure, if not altogether, due to the pressure exerted by the exudate and the congested blood-vessels on the nerves and nerve-endings in the part, and with relief of tension, such as occurs when an abscess is opened, there is great lessening of the local pain.

Thus by means of the blood-vessels great reinforcements of leucocytes and plasma or lymph have been transported to the actual fighting line where the damage to the normal cells is taking place. Assuming the case to be one of bacterial invasion of the tissues as the result of a scratch or wound, the question arises as to the exact rôle of these reinforcements. How do they act ? In the case of the leucocytes, chiefly of the polymorphonuclear variety, their function is to mass round about the invading bacteria and proceed to ingest them. In other words, these leucocytes are active *phagocytes*, and in a stained specimen from such an inflamed part many of these cells are seen to have bacteria inside them.

That the bacteria are ingested while still alive is shown by the fact that the leucocytes containing them may be used to infect culture media, when the ingested bacteria will grow and multiply.

The exact effect of the plasma forming the inflammatory exudate is not so easy to demonstrate and is to some extent still a matter of controversy. That it has an important function in supplying extra nutriment to the cells of the part which are actively engaged in defence and repair will be easily understood. But that is by no means its only function.

The following facts will help to an understanding of the important part the exudate plays. Even in 1881 Lister had noted that drawn blood was able within certain narrow limits to arrest the action of putrefactive bacteria. Many observers studied this matter and Pfeiffer at length described the phenomenon of *bacteriolysis*. He showed that if a guinea-pig was made immune by the repeated inoculation of small doses of a virulent micro-organism such as the cholera spirillum the animal's serum became possessed of a new property, that of dissolving and destroying these virulent bacteria. In an actual experiment an immunized guinea-pig had a large dose—5 to 10 times the ordinary fatal dose—of cholera germs injected into the peritoneal cavity, and on removing by means of a pipette small quantities of the exudate which formed in the peritoneum it was seen that the introduced bacteria were first rendered motionless and then gradually dissolved by the fluid. This is not only the case with cholera but with other pathogenic bacteria, against which an animal or man may have been rendered or become immune. Further, there is good evidence that *normal* blood serum possesses this property of *bacteriolysis* in some degree against many bacteria, and it was this property that accounted for Lister's observation.

It will be evident that the whole series of inflammatory phenomena which have been thus far described as resulting from the invasion of a part of the body by bacteria are directed to one end, namely, a defence of the tissue by the bringing up of reinforcements intended to attack and destroy the invader. In other words, the body proceeds to develop a counter-offensive by means of its phagocytes and bacteriolytic serum.

But, as a result of the first attack or injury, there have been some casualties. Some of the cells of the damaged tissue have actually been killed, whether by mechanical injury as by division in the case of a cut by a knife, or by burning in the case of thermal injury, or by the toxic action of bacteria in cases of septic infection. These dead cells may be very few in the case of a clean-cut wound, or very numerous in the case of an extensive bruise or burn, or in a severe bacterial invasion of an organ. In most wounds there is, in addition, the escape of more or less blood, and the blood-clot which is formed is simply a mass of dead tissue consisting of fibrin entangling red blood corpuscles. Further, apart from the original injury, the damaged tissue may be invaded subsequently by bacteria, and these will wage war not only on the cells of the part, but also on the leucocytes which migrate into it for offensive or defensive purposes. Thus, in any inflamed tissue there are to be found numbers of dead cells, made up of cells of the tissue itself, extravasated blood, and leucocytes attracted to the part. There is, therefore, something more required than the mere overthrow of the agent responsible for the damage, be it chemical or bacterial, for dead cells themselves act like foreign bodies and continue the irritation and injury of neighbouring living tissues. Dead cells or dead tissues do not remain unchanged, for disintegration and decomposition follow death. This disintegration is brought about to a large extent by the invading bacteria, if such are present, but even in the absence of bacterial infection the dead cells themselves contain ferments which split up the complex material (protein) of the cell substance into simpler bodies. Many of these breakdown products are poisonous and are of similar composition to *ptomaines*. These chemical poisons, the products of dead cells, continue to irritate the surrounding living cells and keep up and even extend the inflammation in the part. Thus it is essential that dead cells and dead tissue should be dealt with in the course of the reaction.

There is also required the repair of the actual loss of tissue resulting from the injury. In the case of an extensive wound or burn this may be considerable. In the case of fracture of a bone new tissue is required to effect union. In inflammation of internal organs and structures there is also some breach in the continuity of the structure to be made good. Thus regenerative growth with repair or rebuilding of the damaged tissue is a further important part of the inflammatory reaction. The resources of the body for these necessary functions must now be considered.

Reparative Phenomena.—Inflammation, as we have seen, is an effect or reaction, and it tends to cease when the cause—an injury of some kind—ceases to operate. The abnormal vascular phenomena gradually subside, exudation into the part ceases, the circulation through the area is revived, the migration of leucocytes out of the vessels diminishes, and repair of loss of tissue begins. An initial stage is the clearing of the ground. Firstly, there is the inflammatory exudate to be removed. If liquid, as in the case of pleural or pericardial fluid, it is reabsorbed by the lymphatics and veins. If coagulated into a solid fibrinous lymph, whether on the surface of a membrane such as the pleura or peritoneum, or forming a solid plug in a small cavity such as an air space in the lung, it is got rid of by a process which combines disintegration by ferment action, and ingestion and removal by large numbers of leucocytes. Dead cells, if comparatively few in number, are removed similarly by the agency of leucocytes which ingest them. In this process the large mononuclear leucocytes take a prominent part. If instead of a few dead cells there is a mass of dead tissue the two processes of breakdown by ferments and invasion and ingestion by leucocytes go on together. By these means the mass of dead tissue is gradually separated off from the adjoining living tissue, and if near the surface of the body the dead-piece may slough off. Such is the common result in the case of a superficial burn, or a bed sore, or a severe saddle gall on a horse's back. If the dead tissue is deeply situated it will be either completely ingested by leucocytes and removed piecemeal, or if too large for this it will set up, as a result of the chronic prolonged irritation due to its presence, another type of reaction on the part of the living tissues. This has for its object the complete shutting off of the dead tissue, by the formation round it of a capsule of connective tissue.

Regenerative growth to supply the loss of tissue results from the germinal activity of the uninjured living cells of the part. The cells of all tissues do not possess this power of regenerative repair to an equal extent. It is especially well developed in simple connective tissue—white fibrous tissue—and in the endothelial layer of the wall of blood-vessels. New fibrous connective tissue is formed in the same way as the original normal connective tissue, namely by the agency of fibroblast cells, the descendants of connective tissue corpuscles. It is possible that some of the migrated leucocytes may also take on this function and become fibroblasts (Metchnikoff). For the repair tissue to be adequately nourished it must be provided with blood-vessels, and in the formation of these the endothelial cells of existing vessels play the chief part. If a capillary vessel at the margin of an area undergoing repair be observed it is found that conical buds arise at intervals and by rapid multiplication of the endothelial cells a number of solid endothelial processes project from the wall of the vessel. As each process grows it becomes hollowed out at the base and blood enters and distends it. The process may come in contact with another similar process so as to form a loop or it may bend back and rejoin the parent vessel. By this means a series of capillary loops are formed. Outside the endothelium of these new vessels are young fibroblasts forming new connective tissue layers, and so arteries and veins are provided in the new tissue.

Epithelium and periosteum are also possessed of the power of regenerative repair in a high degree, so that if the surface of a mucous membrane or that of a piece of bone is denuded, the epithelial or periosteal cells outside the injured area grow in to cover over and make good the defect. On the other hand, muscle tissue possesses this power to a very slight extent, and nerve cells probably not at all. To study these later stages of inflammation recourse must be had to microscopic sections made through injured parts showing different degrees of injury and the reactions provoked by them at all stages. The healing of wounds and the repair of fractures of bones also illustrate many of the processes, being in fact important types of inflammatory reactions.

Healing of Wounds.—In the simplest case where without bacteria entering there is a simple section of tissue with destruction of a number of cells and injury to others, and where the wound is either so small that the edges come together or are kept in apposition by surgical means, healing takes place by the method known as " first intention." There is at first an oozing of exudate or lymph, an escape of leucocytes and probably some red cells. Fibrin is formed and a clot fills up the small space between the apposed edges forming the " provisional cement substance." Within the next twenty-four hours the tissue cells bordering on the wound enlarge, send out processes, and divide, so effecting a bridging of the gap by means of these interlacing cells. The débris of dead cells and blood-clot is removed by wandering phagocytes, chiefly mononuclear leucocytes. The capillaries on each side of the gap put out endothelial buds which become hollowed out to form vessels and in a few days the wound is healed.

A shallow surface wound or abrasion heals in a very similar manner " under scab." The scab is made up of desiccated blood-clot or exudate enclosing a number of dead cells. It acts as a support holding the parts together, and since it is hard and quite dry it is also a protective covering in which bacteria cannot propagate.

If there has been more loss of tissue, whether at the surface of the body as in the case of an extensive lacerated wound, or in the depth of some internal organ by reason of some cause, usually bacterial, leading to death of a large mass of tissue, the process will be somewhat different. Considering first a deep-seated mass of dead tissue, we have seen that this will keep up a continuous irritant action on adjacent living tissues especially if infected with virulent bacteria. Into the zone just outside the dead tissue leucocytes will come crowding. The bacteria in the dead tissue will be most active in the zone adjoining the living tissues, for they are constantly seeking to extend their raids into more and more of the healthy tissue. Thus this junction of living and dead tissues is the battle-ground between the leucocytes and bacteria, and many leucocytes are destroyed in the fight. As they are disintegrated they set free a protein-digesting ferment similar to *trypsin*, and this digests the dead tissue with which it comes in contact. Meantime the living leucocytes are ingesting both bacteria and dead tissue cells, and so by a combination of the digestive action of the ferment and the phagocytic action of the leucocytes the mass of dead tissue is cut off from the living tissue. If near the surface of the body the dead tissue is called a *slough*, and its separation leaves an open wound which will heal by the method of *granulation*. If deep-seated, the dead piece is called a *sequestrum*, and it lies more or less free in a cavity with a liquid or semi-liquid material round it, containing the débris of dead tissue cells, dead leucocytes, and dead bacteria.

But all the bacteria in the cavity may not have been killed, and in that case they will be seeking to extend their conquered territory. In any case the poisonous products of the dead tissue breakdown are injuring neighbouring living tissues, and so the body must interpose a barrier to completely shut out the irritants, whether living (bacteria) or dead (poisonous breakdown products). This barrier is built up of the same materials as, and in a similar fashion to, the scar tissue which fills the gap in an open wound. We can therefore look upon the formation of a fibrous tissue capsule round a dead mass as essentially the same process as the healing of an open wound by the method of " granulation."

If the cut surface of an open wound be carefully observed it will be noticed that at first the divided tissues are distinct, but that they are congested with blood, and a considerable amount of clear lymph is exuding. After one or two days this exudate becomes thick and opaque, and if it be examined microscopically it is rich in cells (leucocytes). On the third or fourth day the wound surface has a characteristic granular appearance from the presence of large numbers of minute red points forming a covering like velvet pile. These are the commencing "granulations" and they are bathed in the exudate still more or less opaque from its contained cells. If a microscopic section through the granulation tissue be examined it will be seen that each granulation contains one or more endothelial loops budded out, as already described, from the wall of a capillary. Round these minute blood-vessels are cells, either one or other type of leucocytes, or *fibroblasts*. In the connective tissue bordering on the wound are connective tissue corpuscles, and these by repeated division under the stimulus of the injury give off wandering cells which migrate into the granulations to become fibroblasts. In addition it is possible that some of the migrated leucocytes, notably the large mononuclears, take on this function, and the vessel endothelium may also supply cells to act as fibroblasts.

Whatever their origin these fibroblasts in the younger superficial layers are rather large, roundish cells with a round or oval nucleus in the centre of the cell. In the older layers at the base of the granulation the fibroblasts have become spindle-shaped, or stellate, and fine fibrillar processes project from them. Gradually the cell protoplasm is used up in forming these fibrillar processes until the nucleus is left almost bare. In between the cells there is now laid down an intercellular substance probably secreted from the cells, and in it fine fibrils develop. In this way white fibrous connective tissue or scar tissue is formed. It is at first vascular, and plentifully supplied with nuclei, but in older formations it is much less vascular, more fibrous, and has fewer cells in it. Further, the older it gets the more it shrinks, becoming denser and paler from the squeezing out of the unnecessary capillaries. Thus, by the growth of granulation tissue the wound cavity is filled up with connective tissue which gradually contracts down into firm scar tissue. Meantime the epithelial cells at the skin margins are multiplying or proliferating, and tending to creep in over the surface of the granulation tissue. The young epithelium appears as a delicate bluish-pink pellicle, and it gradually extends in from the periphery until, if the area is not too large, it covers the whole surface, when the wound may be said to be healed. In the case of very large wounds the growth of epithelium is unable to cover the surface before dangerous contraction of the granulation tissue has occurred. Unable to obtain an epithelial covering the scar tissue contracts and often produces very serious distortion of the part. Such an occurrence is frequently seen after extensive burns. To avoid this the parts must be maintained in proper position by splints or bandages, and skin grafts must be used to cover the raw surface. Every little island of living epithelium which can be got to take root upon the granulation area will extend in all directions, and by the coalescence of a number of such islands the surface will be covered with epithelium.

Returning to the consideration of the mass of dead tissue deep-seated in some organ or tissue, it will now be understood that the fibrous capsule that shuts it off from the surrounding healthy living tissue is formed in an exactly similar fashion to the scar tissue filling in a wound. The granulations now line a cavity in which the dead tissue lies. If the dead mass is small it may gradually be ingested by leucocytes or digested by ferments, and the granulation tissue extending in on every side may fill up the cavity. If the dead mass is too large for this it will either remain as a dry, yellowish-white rather tough amorphous material, or it will break down into thick liquid pus. This pus consists of the broken down tissue and of large numbers of degenerated leucocytes. By absorption of its liquid contents and the gradually increasing pressure of the contracting capsule the pus becomes inspissated, *i.e.* paste-like or even dry and firm, so as to be crumbly when cut into. The capsule of fibrous tissue may be of considerable thickness; its wall is dense and almost avascular, and the contents are generally sterile, all the bacteria having been destroyed.

In both these cases, the large open wound, and the internal bacterial infection with the death of a larger or smaller mass of tissue, we have assumed the bodily inflammatory reaction to be adequate to effect on the one hand healing and on the other encapsulation of the dead tissue. But the reaction is not always adequate or successful, nor is it always of the same kind. We must therefore consider more fully different types of reaction and their results.

Types of Inflammatory Reaction.—The reaction necessary to overcome and repair the results of an injury will depend mainly on the particular organ or tissue injured and on the cause of the injury. Dealing first with the latter, we can make the broad distinction into injuries involving bacterial invasion and those in which there has been mechanical or chemical injury only, without either primary or secondary infection with bacteria.

As an example of purely mechanical injury we may consider a *surgical wound* made in the course of an operation with all the modern precautions for preventing the entrance of micro-organisms. Such a wound with proper closure heals in the manner described, "by first intention." Again, a *simple fracture* of a bone is uncomplicated by bacterial infection. Some of the bony tissue has been destroyed; there has been some escape of blood, which remains as dead tissue; muscles in the vicinity may have been injured and some muscle fibres killed. Here the reaction is very similar to that seen in healing by granulation. Exudate is poured out between and around the ends of the two fragments; leucocytes invade the part to ingest and remove the dead tissue; and active bone-forming cells (osteoblasts) come in from the periosteum and from the bone marrow to build up new bone, using the plastic exudate, which in the meantime is assisting to hold the fragments together, as a scaffolding.

A *sprained tendon* is another example of uncomplicated mechanical injury. Fibres have been ruptured, some blood has escaped at the seat of injury, and considerable inflammatory exudation usually follows. The inflammatory reaction consisting of the phagocytic clearing-up work of the leucocytes, and the reuniting or welding of the severed fibres by means of new fibrous tissue formed by fibroblasts, generally completes the repair provided that the part is kept at rest. With considerable damage the amount of repair tissue needed is also considerable, and its subsequent shrinkage accounts for the frequently observed contraction following a sprained tendon.

By far the great majority of injuries are, however, either directly due to bacterial infection, or if mechanical in origin they are complicated later by bacterial invasion of the injured part. Much will depend on the particular bacteria concerned, for these organisms differ in virulence very greatly, and consequently in the inflammatory reactions they give rise to. Some organisms of high virulence so overwhelm the defences of the body that practically no reaction occurs. The anthrax bacillus in cattle is an example, for this organism by whatever channel it obtains an entrance rapidly invades the blood stream and the animal dies of *septicæmia.* In man, anthrax is less virulent so that infection by means of a superficial skin wound or scratch does set up an inflammatory reaction in the form of increased blood flow (hyperæmia), exudation, and a barrier of leucocytes ("malignant pustule").

Other bacteria are less formidable. To infection with this class—the common pyogenic organisms—the reaction is rapid and effective, *i.e.* they cause acute inflammation. The chief feature is the extraordinary migration of polymorphonuclear leucocytes into the invaded area, so that the bacteria are surrounded by armies of white cells and an abscess is formed.

Still a third class of bacteria may be mentioned whose powers of injury are more or less evenly balanced against the defensive reactions of the body. Here the fight is a prolonged one, in other words, the inflammation remains chronic. Such a condition is seen in most cases of tuberculosis and in actinomycosis.

Of the acute inflammatory reactions there are several types distinguished, mainly by the extent of the leucocytic migration from the vessels of the inflamed area. In the *serous* type there is abundant exudation but few cells. In the *suppurative* type there is an immense diapedesis of white cells, with the formation of pus. Between these two extremes is a type of inflammation often called *fibrinous* in which there is abundant exudate and subsequent moderate invasion with leucocytes. Such is the type commonly seen affecting the serous membranes, pleura, pericardium, and peritoneum. The bacterial irritant causes widespread damage and even death of the layer of endothelial cells covering the membrane. The exudate, with some leucocytes in its meshes, coagulates on the surface, forming a protective layer. When the causal bacteria are destroyed and resolution commences phagocytes come in to remove the débris of the fibrinous layer, whilst the remaining living endothelial cells multiply and proceed to spread a new endothelium over the previously inflamed surface. If the damage is more extensive with destruction of all the endothelium, the fibrinous layer is replaced by granulation tissue, and if this occur on both parietal and visceral surfaces of the membrane, fibrous adhesions or bands passing from one surface to the other are likely to form.

When acute fibrinous inflammation affects a mucous membrane such as that lining the larynx, intestine, or bladder, the irritant or injury usually gives rise to necrosis or death of the surface layer. There is at the same time great engorgement of the capillaries and of the membrane with exudate, and this, together with dead or dying cells and leucocytes, coagulates on the surface to form a "false membrane." At first this is firmly attached to the subjacent living cells so that detachment is difficult and causes bleeding. Later, the phagocytes separate off the dead from the living, and so occurs the detachment of the "false membrane." This is the *croupous*, or *diphtheritic*, or *membranous* type of inflammation.

A slighter degree of injury of a mucous membrane will cause *catarrhal* inflammation. Here the chief feature is irritation rather than necrosis of the superficial layer. The surface cells are stimulated to rapid division (proliferation), and the newly-formed cells are cast off (desquamation) into the exudate. The vessels of the part are greatly distended, there is considerable exudation, some leucocytes are thrown out, and characteristically the epithelial cells secrete a large amount of mucus.

Thus a liquid layer consisting of exudate, mucus, leucocytes, and desquamated epithelial cells covers the surface and is to some extent protective and bactericidal. With removal of the irritant the phagocytes clean up the dead cells and coagulated exudate, and a new epithelial layer is formed by proliferation and spread from any undamaged epithelial cells left.

The *suppurative* type of inflammation is characterized by the great migration of leucocytes into the injured area. Many of these cells die in the struggle with the bacteria, though they are not at once disintegrated and dissolved, but remain. Thus there is formed a thick, creamy, opaque fluid called pus which on microscopical examination is seen to be a suspension of leucocytes in a fluid, the inflammatory exudate. Some of the cells stain well and may be seen to contain ingested bacteria; others have broken-down, badly-staining nuclei and are degenerated or dead cells. If the cells are filtered off a thick albuminous fluid is left. When a quantity of pus is confined in a circumscribed space the condition is known as an "abscess." Because of the tryptic ferment in pus and by reason of the pressure it develops an abscess tends to *point*, *i.e.* to come to a head in the direction of least resistance. If near the surface of the tissue it bursts, its contents are evacuated, and in a favourable case the cavity fills up by the growth of granulation tissue from its walls. In other cases, as we have seen, collections of pus tend to become encapsuled with a fibrous tissue wall.

A somewhat similar type of inflammatory reaction occurring in an area covered by mucous membrane or skin usually results in an *ulcer*. The surface cells die as a result of the initial injury or of bacterial infection, and these dead cells are cast off. Thus a raw infected surface is left, and as the bacteria multiply, more and more cells die so that the ulcer extends both in area and depth. With many infections leucocytes invade the area in large numbers; there is an exudation of lymph from the vessels; and as a consequence the surface is bathed in a layer of pus. The digestive ferments of the pus destroy more and more of the superficial cells and this again continues and extends the ulcer. Ulceration is especially liable to occur in situations or in tissues where the circulation is deficient. In the dog it is quite common to get ulceration of the tip of the tail or the tips of the ears. In these cases bacterial infection may occur secondarily and help to continue the inflammatory process, but the condition is due primarily to a mechanical injury in a part where the blood flow is insufficient to promote healing by bringing up plentiful supplies of fresh lymph. In other cases of ulcer the bacterial infection is the primary cause, and until the bacteria have been destroyed they will continue to destroy, cell by cell, layer by layer, and the ulcer will continue.

Ulcers are much more difficult to treat in old or debilitated or anæmic patients than in young vigorous ones. Lastly, any mechanical impediments to the free flow of blood through the part, such as tight bandaging, or the upright posture in the human subject affected with ulcers on the leg, or the existence of varicose veins, are against successful treatment. The methods required in such cases are destruction of the infecting micro-organisms by antiseptics or other means; improvement of the circulation through the part; support of the dilated varicose veins of the part by very gentle pressure; and toning up the constitution of the animal.

One other type of ulceration must be clearly distinguished from these inflammatory ulcers just described, and that is ulceration due to malignant tumours such as *carcinomata*. The ulcers so caused are not inflammatory in origin, although they may become inflamed secondarily, as a result of infection with bacteria. The point to be thoroughly grasped, however, is that disinfection with destruction of all the bacteria, and improved circulation through the part to promote repair, will not effect healing and cure in the case of these malignant tumours.

In some cases of suppurative inflammation the abscess may be deep-seated, but the pus burrows through the tissues and eventually comes to the surface through a longer or shorter channel called a *sinus*. The sinus may be simple or direct, or it may be winding, and have off-shoots or side-tracks eaten out in the tissues by the digestive action of the pus or its contained bacteria. In any case, the sinus almost always has a somewhat thick wall of callous fibrous tissue. This has been built up by fibroblasts belonging to the healthy tissues through which the pus was making its way in order to wall off infection from themselves. Such a sinus shows little tendency to close even after it has opened on to the surface and discharged the abscess contents. In the first place, the thick wall does not easily collapse and close the channel. Secondly, it is very likely to retain bacteria in its lining, for it is not any longer very vascular, and leucocytes and lymph do not easily penetrate its thickness to reach the invading organisms. Not till this callous non-vascular infecting pipe has been dissected away will the sinus heal up.

Even when this has been done success may not be achieved in some cases, for there may still remain that source of chronic irritation already described—a piece of dead tissue in the abscess cavity or at the depth of the sinus. Hard resistant tissue such as bone or cartilage, when killed off by injury, bacterial or mechanical, is particularly likely to cause a chronic discharging sinus. For this reason it is necessary to probe carefully such a sinus, and if dead bone, rough and grating to the probe, is discovered, its removal by operation is the first step in treatment.

Inadequate Reaction.—And now there remain those cases in which the attempt to cope with the injury, and especially the continuous injury due to chronic bacterial infection, is insufficient. Chronic inflammation may be the result with a gradual increase in extent of the damaged or destroyed tissue until the animal dies exhausted. Such is often the case with tuberculosis of the lungs. Infection occurs and the bacillus of tuberculosis begins to multiply in the lung tissue, gradually extending its range and penetrating further into the adjoining sound portions of the lung. The reaction of the tissues is not very active, there is a migration of leucocytes into the area, especially of lymphocytes, and there are large numbers of *epithelioid* cells which may have originated from the large mononuclear type of leucocyte or from connective tissue corpuscles, or from the endothelial cells of the capillaries. The most interesting feature is, however, the presence of *giant cells*, usually as large as five or six leucocytes together. These cells have multiple nuclei arranged in a ring or crescent round the edge of the cell and they often contain many tubercle bacilli which they have ingested and are attempting to destroy. We have here a structure very similar to the " plasmodium " seen in primitive types. The bacilli may be destroyed to a large extent but usually many of the tissue cells die and a sufficient number of organisms remain alive to extend the area of the disease. The tissues may in a few cases react sufficiently to erect fibrous tissue barriers, but the infection even then often remains virulent, only awaiting a favourable opportunity to escape and become active again.

Besides tuberculosis there are other cases in which the enclosing wall of fibrous tissue may be insufficient for the same reason, viz. that there remains virulent (*i.e.* infective) material inside the enclosure. This material insidiously but continuously seeks to escape by attacking the wall cell by cell. At length, usually when some abnormal strain is put upon the tissue, the capsule becomes permeable and the virus either sets up another focus of infection in that animal, or is voided in some way and infects other susceptible animals. Such cases occur sometimes in horses which have (apparently) recovered from *pneumonia*, and much more commonly in cattle recovered from one attack of *contagious pleuro-pneumonia*. Hard work, poor feeding, over-driving, or the coexistence of some other disease such as tuberculosis in the lung, may all be held to account for the " lighting-up " of the old infection, but the essential reason is that the infecting virus was not completely destroyed after the first attack of the disease, but has lain more or less dormant inside the insufficient fibrous tissue barrier.

Still another type of chronic inflammation is exemplified by *arthritis*—inflammation of a joint. Horses used for hard or fast work often suffer from arthritis as a result of the frequently repeated concussion. The pastern joints, the hock, and the stifle are commonly affected. In the great majority of these cases there is no bacterial invasion, but the injury is purely mechanical.

The tissues surrounding the joint react and endeavour to repair the injury by buttressing the joint. At first there is heat, pain, lameness. If the joint were then opened and examined it would be found hyperæmic and often filled with an excess of synovia. Later in the disease with a continuance of the injury the aforetime smooth cartilage-covered articular surfaces are found roughened and eroded. Then the reaction often proceeds to lay down fibrous tissue in the soft structures surrounding the joint in order to strengthen it, and even stimulates the bone-forming cells (osteoblasts) in the inflamed periosteum to form new bony layers in the joint walls. The chronic inflammatory reaction has for its object the ending of the excessive friction and concussion which are damaging the joint. The consequent pain and lameness usually compel the animal to rest. If made to work by a cruel, ignorant or avaricious owner the damage will increase to such an extent that the sensitive, delicately moulded joint surfaces are destroyed and nature's only resource is to buttress and stiffen the joint so that it becomes fixed or *anchylosed*, and then, eventually, with enforced absence of friction, callous—but no longer a joint.

Other cases are more immediately unfavourable. Sometimes the infection or primary injury effects the death (necrosis) of a considerable mass of tissue. Following this putrefactive bacteria settle in or upon the dead mass and *gangrene* supervenes. As a result of the absorption of toxic material from the dead putrid tissue septic intoxication occurs and the animal dies from *toxœmia or saprœmia.*

In other infections, the causal micro-organisms extending in the affected tissue invade the lymphatic vessels or even a vein. In the former case a condition of septic lymphangitis may be set up with production of multiple abscesses along the course of the lymphatic vessels, up to and including the next group of lymphatic glands. Such cases may end favourably by the expulsion of the invading micro-organisms from the abscesses. They may result unfavourably if the glandular reaction is ineffective as a barrier and the bacteria reach the thoracic duct and blood stream. In those cases where micro-organisms reach the blood stream, whether through a vein direct or *via* the lymphatics, the results are always serious. Sometimes the bacteria are simply transported in the blood stream until they reach some set of fine capillaries which filter them out. Such capillaries are found in the lungs, liver, kidneys, and brain, to mention the more important situations, and the bacteria filtered out and held in these organs begin to grow and multiply, setting up new foci of disease, usually in the form of multiple abscesses. This condition is known as *pyœmia*.

In other cases the bacteria find the blood itself a congenial medium for growth and multiplication. In a very short time the blood swarms with bacteria and a fatal result is inevitable. This condition is known as *septicœmia*.

Clinical Signs and Symptoms.—As a rule the first indication of inflammation in a part which compels attention on the part of the owner of an animal is impairment of function. A horse gets a sprained tendon and goes *lame*, or an animal refuses food and salivates, and on inspecting his mouth *stomatitis* is discovered. A frequent cough, aggravated by feeding, and much increased by pressure over the larynx suggests *laryngitis*. Detailed examination of the affected part then provides evidence of one or more of the cardinal symptoms, pain, heat, redness, and swelling. In the case of deep-seated tissues these signs may be absent, but by means specially adapted to the various organs evidences of local inflammation are to be obtained. There are, however, in addition certain systemic or general effects of any severe inflammatory reaction. Usually there is more or less fever, with rise of temperature, frequent pulse, and quickened breathing. The appetite may be lessened. The animal may adopt a characteristic attitude indicative of pain, sometimes pointing to its localization, and usually adapted to reduce the pain to a minimum. With septic infection and the absorption of toxins special nervous symptoms, drowsiness, stupor or even coma may develop, or in other cases delirium and convulsions. The localizing value of symptoms and the diagnostic value of the signs of inflammation of special parts must be sought for in the sections treating of the diseases of special parts.

General Principles of Treatment.—It is a somewhat trite but very true statement that discovery and removal of the cause are the first steps in treatment. The continuance of any mechanical injury must be obviated; poisonous chemical agents must be put out of action; invading bacteria must be destroyed. Then repair of the damaged tissue may be attempted. The methods to be adopted to attain these objects are many and various, but there are certain definite principles of treatment which appear to follow from our understanding of the nature of the inflammatory process.

Firstly, the "lines of communication" between the affected part and the rest of the body must be kept open so that reinforcements of leucocytes and lymph may be brought up, and waste products removed. This points to an attempt to restore and improve the circulation through the blood-vessels of the part. To this end hot fomentations are commonly applied in the early stages, and massage in the later.

Secondly, it may be advisable to flush the part with fresh lymph, in order to provide ample nutriment for repair, and bactericidal fluid for killing off the infecting micro-organisms. This is brought about by such procedure as the old-fashioned method of "cupping" or the modern "Bier's treatment" in which by means of an elastic band placed round a limb, for half an hour several times daily, venous congestion and exudation of lymph are promoted. The application of a blister externally in case of sprain, and the use of hypertonic saline solution on dressings applied to a wound, have the same object, namely, to draw out or cause the pouring out of an exudate of fresh lymph.

As part of the procedure to remove the cause an abscess or any collection of pus should be evacuated as soon as it is discovered. Any dead tissue or "sequestrum" in the depth of a wound or at the bottom of a sinus should be removed as early as possible. Antiseptics may be used with advantage thoroughly to disinfect a wound, or abscess cavity, or sinus. Agents which have a specific effect on the supposed causal micro-organisms when given by the mouth will be used, if there are such. In cases of Actinomycosis, potassium iodide has undoubted specific action and is a good example of what is meant. To promote leucocytic action various methods have been adopted, notably the internal administration of yeast and nucleic acid.

Vaccines, consisting of the dead bodies of bacteria grown in artificial culture from the organisms actually causing the inflammation, are of great value in stimulating the phagocytic activity of the leucocytes and the bactericidal powers of the blood serum. Lastly, the part is put into such a position as to lessen pain, favour the circulation, and promote repair as in the case of a fractured bone or sprained tendon.

For deep-seated inflammations general drug treatment, except the use of agents with proved specific therapeutic properties, is unsatisfactory.

On the other hand, the general condition of the patient may be greatly improved by proper feeding and good nursing in healthy surroundings, especially as regards plenty of fresh air, whilst tonics and stimulants used judiciously may greatly assist in suitable cases.

H. A. W.

WOUNDS AND THEIR TREATMENT

General Remarks.—In popular language a wound may be defined as a breach of the skin or flesh due to a hurt or injury. In scientific language a wound may be described as a forcible solution of continuity or division of the tissues of any part of the body, caused by a mechanical agent or external violence. Wounds vary as regards their gravity and results, these depending on the extent of the injury, the structures involved, the sequelæ and complications which may ensue, the vital resistance of the animal, and last but not least, the treatment adopted.

In veterinary practice the subject of wounds and their treatment is one of vast importance, and this branch of surgery forms a large proportion of the daily work of the veterinarian. Not only has he to adopt measures which are calculated to overcome the immediate and remote effects of wounds, but he must also devote attention to the economical aspect of the subject in the case of horses, so that the treatment he carries out may render the animals fit for work in the shortest time possible, and reduce to a minimum the chances of blemish. The owners of animals can accomplish much in this direction by calling in professional assistance early, and by avoiding irrational measures prior to seeking skilled advice. Attention to the surroundings of the patients and a practical knowledge of cleanliness in dealing with wounds are details which play an important part in connection with the results of treatment, which should be fully recognized in first-aid instruction on the subject.

In common with all medical and surgical conditions associated with animals, the treatment of wounds from the amateur or popular point of view is surrounded by many fads and fallacies. Hence, in dealing with the subject it is essential to discuss the erroneous ideas that are usually held by owners of animals with regard to the healing of wounds, as well as the measures to be adopted in order to assist the natural process of repair.

The first point which merits careful attention is that the healing of wounds is brought about by a natural method of repair. This process takes place independent of surgical interference, and although by adopting certain measures it is possible to assist nature in the work of repair, it is important to remember that if too strong antiseptics or irritants of any kind be applied, healing is retarded instead of being expedited. A common error is to imagine that frequent dressing of wounds is necessary, and to overlook the fact that meddlesome interference is harmful in every branch of surgical work. Lack of knowledge in this direction was responsible for the irrational treatment of wounds practised in former times, and accounts for the erroneous views on the subject held in the present day by many owners of animals.

The next point refers to the prevalent idea that special virtues reside in certain agents employed as wound dressings. The truth is that, provided efficient drainage exists or is assured, the selection of an antiseptic agent is very often a matter of choice provided it does not cause irritation of the tissues. In the absence of proper drainage, the most active antiseptics will fail to bring about desired results.

Experimental studies devoted to the healing of wounds, combined with clinical observation, have led to considerable modification in the views held with regard to the mode of applying antiseptics. It has been shown that such agents, if employed in too strong solutions, cause irritation of the tissues and interfere with the natural process of healing.

In order to gain an accurate idea of the influence for good which the surgeon can exert on the healing of a wound, and in the prevention of serious complications arising from septic infection, it will be necessary to consider the question of natural repair in an aseptic wound, and then to ascertain the effects produced by the entrance of pathogenic micro-organisms.

If it were possible to exclude micro-organisms from wounds, healing would take place by the natural process of repair. Even in cases of lacerated or punctured wounds, complications would rarely occur, as infection is mainly responsible for the protracted course or serious results which often characterize such injuries.

Unfortunately in veterinary practice, except in the case of operations carried out under aseptic (germ-free) conditions, infection to a varying extent occurs in wounds, and what is known as " healing by first intention " is the exception rather than the rule. It may be taken for granted that accidental wounds are more or less septic prior to coming under the care of the surgeon, micro-organisms having gained entrance either at the time of the accident or subsequently through carelessness on the part of the owner of the animal or the attendant.

Technically the term " septic " as applied to wounds means that micro-organisms have gained entrance to the part, and includes infection from any source. Thus a wound in which suppuration occurs is, strictly speaking, septic or infected. In popular language, however, the term "septic" is usually reserved to describe wounds in which a more serious form of infection has occurred, the discharges being fœtid, and the surrounding tissues being involved and invaded by virulent micro-organisms, while not uncommonly there is a tendency for general septicæmia (blood poisoning) to supervene.

As will be pointed out later, the occurrence of suppuration is very common during the healing process of wounds in animals, owing to the fact that it is very difficult to prevent the entrance of pus-producing micro-organisms, either in the case of operation wounds or in those resulting from accidental causes. The surroundings of animals and the lack of trained attendants to carry out the after-treatment are factors which are largely responsible for the occurrence of wound suppuration. In human surgery, owing to favourable surroundings and the facilities for carrying out aseptic technique and after-treatment, it is the rule for operation wounds to heal without pus formation, *i.e.* "by first intention." Even in the case of infected accidental wounds in man it is now possible, by adopting special technique, to render them aseptic.

A short reference to the circumstances under which wounds occur in animals will assist in elucidating our subject.

(1) **Operation Wounds.**—These may be of the type known as incised wounds (see p. 568), or they may involve the loss of tissue, as exemplified by wounds remaining after the removal of tumours, in which case a considerable cavity results, which gradually becomes filled by granulations. In modern veterinary surgery every precaution is taken to prevent infection both at the time of operation and subsequently, but owing to the faulty surroundings of the patient suppuration very frequently occurs during the process of healing.

(2) **Accidental Wounds.**—These form a large proportion of wound cases in veterinary practice, and they occur under a variety of conditions. The nature of accidental wounds varies from a trivial skin cut to deep and extensive laceration of the tissues with injury to important structures such as blood-vessels and nerves, and followed by serious complications which may endanger the life of the patient. In certain regions of the animal punctured wounds, although apparently insignificant on casual inspection, are often followed by serious consequences. Such cases are exemplified by wounds penetrating a joint or involving tendons, and the unfortunate sequelæ depend on the effects of micro-organisms which gain entrance to the part rather than on the mechanical injury inflicted. Accidental wounds may be caused by one horse kicking another, the calkin of the shoe being capable of producing a very serious injury in certain regions.

Shaft wounds sustained during collisions often prove fatal owing to penetration of the chest or abdominal cavity, or from causing rupture of a large artery in a region where it is impossible to carry out ligation of the vessel.

Barb-wire is responsible for many cases of serious wounding of horses at pasture. Extensive and serious wounds in the horse are not uncommon as the result of being "horned" by a cow grazing in the same field. Again, horses when at pasture may take fright and in their wild career may come into violent contact with various obstacles capable of inflicting severe injury on any part of the body. A familiar example of a punctured wound which may be followed by serious consequences is that produced by a "gathered nail" in the horse's foot.

In sporting districts wounds in hunters are of very frequent occurrence, especially in countries where stone walls and banks abound, as in Ireland. Under these conditions the most common injuries are punctured or lacerated wounds of the knee, hock, fetlock, and coronet, arising from contact with sharp stones or from penetration by a pointed stump of gorse. Other wounds incidental to hunting comprise open joints, a severe "over-reach," cuts due to coming into contact with wire, and punctures from thorns (Black thorn). The veterinary surgeon in a hunting district has extensive experience of the above types of wounds, and not infrequently the greatest discrimination and skill are necessary in order to carry out treatment calculated to render the animals fit for work in as short a time as possible, and to prevent the occurrence of permanent blemishes. Trained hunters being valuable animals, it follows that the most approved methods of surgical procedure can be adopted in connection with the treatment of wounds without reference to the question of expense. Moreover, the extra trouble taken is amply repaid by the results obtained.

Repair of Wounds.—In order correctly to appreciate the principles which should guide us in the treatment of wounds it is necessary to be acquainted with the natural mode of repair. In surgical as well as in medical conditions, natural powers of recovery exist, and it is lack of appreciation of this fact which is responsible for the irrational treatment of wounds so frequently carried out by owners of animals. The popular idea is that by applying certain medicaments, healing is achieved, and little or no attention is directed to the evil effects produced by dressings of an irritating character. Again, the question of the inimical action of micro-organisms which gain entrance to a wound is not recognized, hence the carelessness displayed regarding the cleanliness of the patient's surroundings, the hands of the attendant, and the dressings employed. The primary instruction on this subject, for the amateur, should direct special attention to the fact that cleanliness and efficient drainage are of far greater importance than the selection of the dressing in the treatment of wounds.

In considering the natural mode of repair it is essential to remember that the reparative activities of the body are directed not only to make good the divided or injured tissues, but to overcome the invasion of micro-organisms. Hence the importance of avoiding in treatment any measures which are likely to interfere with the process of natural repair.

Another point which merits attention is that although it is usual to describe various modes by which repair may take place the general reparative process is similar in all cases, but is subject to modifications, depending on the character and condition of the wound.

In the repair of wounds the usual ultimate result is the production of cicatricial or scar tissue; this serves as the bond of union and varies in amount according to the degree of approximation of the lips of the wound and the conditions under which healing occurs. It is increased in amount when there is much loss of tissue, when the affected part cannot be kept at rest, and when inflammatory action persists in the wound. Regeneration of injured parts, *i.e.* restoration of the injured structures to their original condition, only occurs in a few tissues, such as striped muscle, tendon, nerve, and bone. It can only take place when the divided parts are accurately approximated and perfect asepsis is maintained. Regeneration is rarely observed in the case of skin or subcutaneous tissue.

It is now necessary briefly to consider the various stages in connection with the general process of repair, and to draw attention to the modifications induced by the character and condition of the wound.

The first phenomenon is the occurrence of a varying degree of hæmorrhage, which in the case of an incised wound is small in amount. The bleeding is arrested by clotting of the blood in the small vessels. The clots (technically known as thrombi) extend from the mouths of the divided vessels to the nearest patent branches.

In this *first* stage of the process of repair a number of leucocytes (white blood corpuscles) exude or pass through the walls of the smaller vessels. These leucocytes remove any dead or damaged tissue that is present, and break up and absorb blood-clots. A certain amount of plasma (the fluid portion of the blood) accompanies the exudation of leucocytes so that the process resembles the early manifestation of slight inflammatory action, and provided it remains within certain limits it is regarded as favourable to repair. This is followed by the appearance of large oval cells termed "fibroblasts," derived chiefly from the cells forming the tissue of the part, the connective tissue, and from the endothelial cells lining the capillaries in the vicinity, the lymphatic vessels and lymph spaces. The result is that a layer of cellular tissue composed of fibroblasts is soon formed and lies on the surface or between the lips of the wound, while the leucocytes disappear.

In the *second* stage "vascularization" of this layer of fibroblasts takes place. In simple language this implies that the layer becomes supplied with blood-vessels, *i.e.* becomes vascular. The process is accomplished as follows: Outgrowths composed of solid rods of protoplasm spring from the walls of the nearest capillaries. These rapidly increase in length and join with similar outgrowths from other capillaries, or with the wall of another vessel, while connective tissue cells may become spindle-shaped and also join the off-shoots mentioned. Next, the outgrowths become canalized (*i.e.* hollowed into fine canals) and communication is established between them and the capillaries, so that blood flows through them, and new vessels are thus formed. The result of the above process is the formation of what is termed *granulation tissue*. This is composed of loops of capillaries supported by large cells with a varying amount of substance between the cells.

The next stage is the transformation of granulation tissue into *fibro-cicatricial tissue*. The fibroblasts assume a spindle shape, and subsequently become long and narrow with pointed extremities which often branch. Around them a fibrillated structure is developed, and ultimately this is changed into the "fibrous tissue of the scar." Contraction of this tissue next occurs and the newly-formed vessels become constricted, resulting in diminished vascularity of the scar tissue, which shrinks, becoming harder in consistence and smaller in extent.

The final stage is reached when the surface of the wound is covered by cuticle, which spreads inwards from the normal epithelium in the vicinity of the wound, especially from the deeper layers of the skin.

Modifications in the General Process of Repair.—As already remarked the general process of repair is modified according to the character and condition of the wound. These modifications may be considered under the following headings: (1) Healing by first intention or primary union; (2) healing by granulation; (3) healing under a scab.

Healing by First Intention.—This takes place in simple incised (clean cut) wounds, when the following conditions exist. (*a*) A practical freedom from infection; (*b*) absence of bruising or injury to the lips of the wound; (*c*) arrest of bleeding, and approximation of the lips of the wound so that it is not possible for an extensive collection of blood or secretions to form between them. Such conditions permit healing to take place in a typical manner as described, the process being complete in a period of from five to seven days.

In veterinary practice, healing by first intention is the exception rather than the rule, except in the case of small operation wounds, when the technique is conducted under special conditions so as to ensure freedom from infection (see p. 564). Owing to difficulties which will be considered under "Wound Infection" healing by primary union is uncommon in equine practice. In canine surgery, however, this mode of healing is practicable under modern conditions of technique and surroundings.

Healing by Granulation.—This is also known as "union by second intention." It is the common mode by which healing takes place in veterinary practice. Formerly, it was believed that suppuration inevitably accompanied the process, but it is now known that if aseptic conditions can be secured, healing by granulation takes place without the occurrence of suppuration. But in veterinary practice, for reasons which will be indicated later, it is rare to find this mode of healing unaccompanied by the formation of pus.

Healing by granulation occurs under the following conditions: (*a*) When the lips of the wound cannot be brought into apposition owing to a definite loss of substance, or when no attempt is made to bring about approximation by the employment of sutures. (*b*) When the surface of the wound is bruised or injured, so that sloughing of a portion of the tissue occurs. (*c*) In cases where healing by first intention is prevented by micro-organisms gaining entrance to the wound.

In cases where simple loss of substance occurs, unaccompanied by bruising or infection of the tissues, the blood-flow in the superficial capillaries becomes arrested and the adjacent vessels become dilated. From these latter vessels an exudation of plasma with escape of leucocytes takes place. The plasma coagulates on the surface of the wound and forms a layer of fibrin, in the meshes of which a number of leucocytes are entangled. This layer gradually increases in thickness, and becomes transformed into granulation tissue in a period of from four to seven days, and subsequently it is converted into fibro-cicatricial tissue and the surface becomes covered by cuticle.

Healing under a Scab.—This process is observed in small wounds and abrasions, and is practically identical with healing by granulation, except that repair takes place beneath a scab formed by the drying of the exudation from the wound. When cicatrization is complete the scab is cast off spontaneously. This mode of healing is common in veterinary practice in the treatment of small wounds by the open method, *i.e.* without any artificial dressing. Not infrequently, owing to infection, pus accumulates under the scab, retarding healing, unless a means of exit is provided.

Wound Infection.—Owing to the fact that infection influences the gravity, course and results of wounds further attention to it is desirable. At one time the occurrence of suppuration in both accidental and surgical wounds was regarded as favourable and healing by first intention was rarely observed. Until Lister investigated the subject, and applied antiseptic principles to the treatment of wounds, practitioners did not realize the importance of surgical cleanliness or the baneful effects of micro-organisms on the process of repair. To-day the necessity and advantage of adopting stringent measures to prevent the access of micro-organisms to operation wounds is universally acknowledged, while the importance of energetic treatment of infected wounds is fully recognized.

In human surgery the technique of aseptic (germ-free) methods has reached a high standard of perfection, with the result that healing of wounds by primary union is the rule in the large majority of instances.

In veterinary surgery, owing to various circumstances, the difficulties in the way of preventing infection of operation wounds are enormous, so that aseptic methods except under very special circumstances are hardly practicable. Similar difficulties exist as regards the treatment of accidental wounds.

In considering these difficulties the following points may be mentioned:

(1) *The Surroundings of Animals.*—So far as the horse is concerned it is obvious that even in the best-constructed stable it is impossible to obtain or to maintain conditions for the prevention of wound infection such as exist in hospitals for human beings. In ordinary stables and surroundings the prevention of infection is far more difficult to carry out.

(2) *Ensuring Rest.*—Rest is a very important element in bringing about healing by first intention. The difficulties in rendering a part immobile, especially of an equine patient, are well known, the inconvenience and pain caused by a wound not infrequently induce movements of the limbs, while the act of lying down or rising exerts a detrimental effect on the healing process.

(3) *Disinfection of the Skin.*—This cannot be carried out with anything like the same facility

in the horse as in man, even though the part be shaved and painted with tincture of iodine. No doubt these precautions have the effect of lessening the risks of infection, but the ideal aseptic condition of the skin obtained in human surgery is not often attainable in veterinary practice.

(4) *Subsequent Treatment.*—Unless aseptic treatment can be maintained during the entire care of a wound case the early attempts at ensuring freedom from infection cannot be expected to produce desired results. Hence it would be necessary for the veterinary surgeon to dress the wound with his own hands, as he could not rely on the attendants to observe aseptic precautions. Needless to remark, this course would not be practicable unless the patient were treated in an infirmary. Even with a trained attendant there are many difficulties in securing ordinary surgical cleanliness.

While admitting the drawbacks as regards prevention of infection in the treatment of wounds in veterinary patients, we must point out the necessity of adopting every means in our power to limit the entrance and development of micro-organisms. As we shall show later, infection varies with reference to the gravity of the results produced, this depending on the virulence of the infecting agent and also on the powers of resistance possessed by the animal. By adopting surgical cleanliness and care in the employment of antiseptics we are often able to prevent the entrance of virulent micro-organisms into wounds, and even if they have been accidentally introduced their development and effects may be overcome by judicious treatment. Hence, there is no excuse for the prevailing notion that because aseptic methods are not practicable to the same extent as in human surgery, it is unnecessary to be particular as regards surgical cleanliness and the adoption of measures to prevent infection of wounds in animals. The fact that a wound is already infected should not render us less careful in preventing further infection, remembering always that, owing to the surroundings of animals, neglect in this direction may result in the entrance of a more virulent type of micro-organism than that already present.

In further consideration of wound infection it is desirable to direct attention to the effects produced by the action of pus-producing micro-organisms. According to modern authorities these effects are as follows: healthy reparative action ceases, and is replaced by an inflammatory process of a suppurative type. The inflammation may be regarded to a certain extent as protective, as it antagonizes the action of the micro-organisms.

The suppurative process may be confined to the wound, or infection may extend into adjacent tissues and produce "cellulitis." In deep-seated wounds an abscess may be produced.

Various sequelæ may occur from wounds as the result of infection, such as septicæmia (blood-poisoning), erysipelas, malignant œdema, tetanus, etc., these depending on the nature of the infecting agent.

As already pointed out, the term "septic" is one which is not infrequently applied to designate a variety of conditions. From one aspect it is employed to describe a wound which suppurates, in contradistinction to one which is free from germs, *i.e.* aseptic. In practice, however, the term septic is often reserved for wounds which are offensive or putrid, associated or not with the presence of pus. A large proportion of wounds in animals heal by granulation, suppuration to a varying extent is present, but the pus is not offensive, and with ordinary care no complications arise. Such cases are not usually designated as septic, but obviously they cannot be described as aseptic. In order fully to comprehend the principles of the treatment of wounds, it is necessary to know something of the micro-organisms which are responsible for infection and the means at our command to prevent and to combat their action.

The Micro-organisms responsible for Wound Infection.—The most common, and hence the most important of these in everyday practice are included in the group known as the Pyogenic cocci. The following merit special attention:

Staphylococcus pyogenes aureus is responsible for the majority of suppurative inflammations, and is often associated with other pyogenic organisms in connection with wound infection (mixed infection). It is very widely distributed, and is found abundantly in the superficial layers of the skin. Its power of producing suppuration has been demonstrated experimentally.

Streptococcus pyogenes plays a very important rôle in the wound infection of animals. Varieties of this micro-organism probably occur, but owing to a resemblance in their characters it has not been possible to isolate them. The *Streptococcus pyogenes* is responsible for spreading cellular inflammation, septic peritonitis occurring as the result of wounds involving the peritoneal cavity, and as a sequel to castration. It has a special tendency to invade the lymphatics and also to induce sloughing of the tissues, and not infrequently it is the causal agent in septicæmia and pyæmia.

Erysipelas, a form of wound infection, is said to depend on the *Streptococcus erysipelatis*, but in appearance and cultural characters it resembles *Streptococcus pyogenes* so closely that many authorities regard them as identical.

A variety of *Streptococcus pyogenes* termed *Streptococcus equi* is regarded by some writers as the causal factor in strangles, but its specific character has yet to be demonstrated. At any rate, we are fully aware of the necessity of guarding against the danger of pus from a case of strangles gaining entrance to wounds.

Amongst other causal agents in wound infection we may mention the tetanus bacillus, the bacillus of necrosis, the bacillus of malignant œdema, the bacillus pyocyaneus, and the tubercle bacillus. Wounds may also be infected by the entrance and development of Botryomyces, the cause of some cases of "collar tumours" and scirrhous cords. In rare instances a wound may be infected by actinomyces, the organism responsible for antinomycosis or "timber tongue" in cattle.

Not infrequently, more than one variety of micro-organism is responsible for infection of a wound, and from the clinical point of view such "mixed infections" are often difficult to combat.

Modes of Infection.—Having indicated the chief causal agents in wound infection, it will now be necessary to consider the manner in which they gain entrance to a wound. Such knowledge is essential in order to adopt preventive measures in dealing with both surgical and accidental wounds.

(1) *Infection by Air.*—It is now held that germs exist in the atmosphere only in the form of dry dust and that air perfectly freed from dust is harmless to wounds. Moreover, when the air is kept still, wound infection rarely takes place through the atmosphere. But when we consider the surroundings of animals, we must admit the probability of infection through the medium of air containing dust. During the process of grooming the horse, of cleaning out the stall, removing the clothing, and arranging the bedding it is easy to understand how dust impregnated with micro-organisms is enabled to gain entrance to a wound. In the case of operation wounds dust is a prolific source of infection. It may be derived from the bed of straw on which the patient has been cast; also from animals with dirty shaggy winter coats, dust is freely disseminated during the struggles consequent on casting and securing them for operation.

(2) *Infection from the Surroundings.*—Under the usual conditions of practice it is quite apparent that aseptic surroundings are difficult if not impossible to obtain. Although every precaution may be attempted in the initial treatment of a wound, it is obvious that infection to a greater or less extent is likely to occur from the floor of the stall and from the bedding, more especially in ordinary stables. Without doubt insanitary buildings are a fertile source of infection, a fact which has been well demonstrated in connection with the after-treatment of castration cases. In such instances septic peritonitis is not uncommon as a sequel, when colts are confined in filthy stables. On the contrary, it is rarely encountered when the animals are left on pasture immediately after the operation. The baneful influence of a vitiated atmosphere is also recognized as a factor in the production of sepsis, as it lowers the vital resistance of the patient.

Similar remarks apply to the results obtained in the treatment of all types of wounds when the animals are kept in filthy surroundings, as under such conditions the most virulent forms of infection are likely to occur.

(3) *Infection from the Operator or the Attendant.*—This constitutes a very serious and important source of infection, and one that is not infrequently overlooked. A prevalent idea is that with a free use of antiseptic agents the risks of infection from the hands of the operator or attendant may be ignored. Practical experience has shown the necessity for surgical cleanliness in connection with the hands and other details relating to the care and dressing of wounds. Judging by the neglect which is not uncommonly displayed in relation to wound dressing, one may be pardoned for expressing surprise that a greater number of serious cases of wound infection do not occur. The natural power of resistance to infection which is so highly developed in many animals explains how carelessness in connection with the dressing of wounds is not always followed by serious if not fatal results.

Infection likely to arise from contaminated hands is preventable by the exercise of simple measures of cleanliness, yet we know how difficult it is to get such measures carried out in practice. The energetic use of a nail-brush with soap and water is essential before rinsing the hands in a disinfectant solution. Obviously, it would be courting disaster to perform an operation or to dress a wound immediately after opening a strangles abscess, dressing a wound in a case of septicæmia or one of tetanus, or conducting a post-mortem examination. Under such conditions the veterinary surgeon should postpone operations or the dressing of wounds until such time as he can render his hands surgically clean, and we may add that when the hands have been contaminated a very thorough and prolonged disinfection is necessary to cleanse them.

(4) *Infection from Surgical Dressings, etc.*—Carelessness in dealing with surgical dressings and utensils employed in the treatment of wounds is responsible for many cases of infection. Repeated instruction is required before the ordinary attendant can be made to recognize

the importance of keeping surgical dressings such as cotton wool, gauze, etc., free from contamination. Too often they are placed on the floor during the dressing of the wound, or they may be soiled by the hands of the dresser, and thus act as a carrier of infection. Similar remarks apply to the solutions employed and the vessels containing them. The popular idea is that provided an antiseptic is added to the water the cleanliness of the latter is not of much importance, while little care is given to the condition of the vessel containing the solution. Another fertile source of infection is the employment of sponges which have become contaminated by previous use, or as not infrequently happens, have been utilized for various purposes in the stable. Sponges, other than those specially prepared for surgical use, are unsafe and should not be used. Swabs of cotton wool which can be discarded after each dressing are safer and quite as serviceable.

Infection from Sutures.—The necessity for ensuring that sutures are in an aseptic condition cannot be too clearly emphasized. This point will be again referred to under "suturing of wounds."

Infection from Instruments.—Every modern practitioner recognizes the necessity for sterilizing instruments prior to use, and is aware that by boiling them for fifteen minutes all danger of infection from this source can be removed.

The instrument which in the hands of the layman is a frequent source of infection is the syringe used for injecting wounds. Needless to remark, it is exceptional to find this instrument really clean or disinfected, and the use of a contaminated syringe is more likely to introduce infection than to destroy germs already existing in a wound. Obviously no syringe except one that is capable of being sterilized by boiling should be employed by either professional or layman.

Circumstances predisposing to Infection in Wounds.—Certain conditions are especially liable to favour infection in wounds. These may be classified as follows :

(*a*) *Deficient Drainage.*—Unless a means of escape for the discharge of serum is provided, this material accumulates within the wound and forms a suitable nidus for the development of micro-organisms. The amount of this discharge varies according to circumstances, and is especially profuse in the case of lacerated wounds. A typical example is found in castration wounds, in which instance, unless the openings in the scrotum are made of sufficient length, the skin wounds heal rapidly, a large amount of serous discharge accumulates, and if this is not liberated it soon becomes putrid, leading to unfortunate results. The retention of blood-clots in a wound is also an important factor in favouring infection, as they form a nidus for micro-organisms. The subject of drainage will be again referred to under the treatment of wounds.

(*b*) *The Presence of Bruised or Necrotic Tissue in a Wound.*—When tissues are bruised their vitality is either weakened or destroyed and they offer no resistance to the invasion and development of micro-organisms. Hence the necessity for removing all devitalized tissue in the treatment of lacerated wounds. Another point of importance in connection with surgery is that all necessary manipulations should be carefully conducted so as to inflict as little damage to the tissues as possible.

General Remarks on the Treatment of Wounds

Prior to considering the various types of wounds and the special treatment required for these, it is desirable to discuss some general principles. From the remarks already made, the reader will gather that if infection could be eliminated from wounds treatment would be a simple matter, as healing would take place rapidly and safely. Of course, in extensive wounds important structures might be severely injured or blood-vessels severed, and the suppression of hæmorrhage would also require attention. But such phenomena occupy a minor position as compared with the sequelæ and complications associated with infection. Hence, in the technique of wound treatment the prevention of infection should be regarded as the most important detail. Even admitting that, more especially in the case of accidental wounds, it is not possible in ordinary practice to ensure perfect asepsis, we can at least take steps to prevent the entrance and development of virulent micro-organisms which give rise to serious, if not fatal, complications. If, in our attempts to practise methods calculated to prevent infection, we fail to achieve the measure of success obtained in human surgery, we may rest assured that improvements in our technique will follow, and the ultimate results will repay the time and trouble expended. Here we may point out that our remarks apply to the treatment of wounds under the ordinary conditions of practice. No doubt with special facilities, such as are provided in up-to-date veterinary colleges, it is possible to carry out aseptic methods which are not practicable in everyday work.

It will be necessary to consider the significance of the terms *aseptic* and *antiseptic* as applied to wound treatment.

Aseptic signifies the absence of sepsis, *i.e.* the absence of micro-organisms. The term is synonymous with "sterile" or "germ-free."

Antiseptic is a term that is often loosely applied. Literally it signifies anything opposed to sepsis, while in a bacteriological sense it indicates an agent that retards or prevents the development of micro-organisms irrespective of its power of destroying their vitality. But it is often erroneously regarded as synonymous with germicide. Whereas a large number of agents classed as antiseptics are not capable of destroying pathogenic micro-organisms.

Disinfectant is the term applied to an agent capable of destroying infective micro-organisms, and so far as pathogenic germs are concerned it is synonymous with germicide. It should be remembered that while all disinfectants are antiseptics, all antiseptics are not disinfectants. The germicidal powers of some antiseptics are exceedingly weak.

Deodorant is the term applied to substances that destroy or remove offensive or unpleasant odours. While many disinfectants are also deodorants, it does not follow that all deodorants possess germicidal properties.

In the general principles of wound treatment a distinction must be made between wounds which are made for surgical purposes under special conditions ensuring that the entrance of micro-organisms may be prevented, and accidental wounds which are already infected before coming under the care of the surgeon. As already pointed out, it is possible to practise aseptic surgery in infirmaries provided with special facilities for the purpose. Owing to the fact that the majority of antiseptics interfere more or less with the natural process of healing, by acting injuriously on the tissue cells, and lessening the vital resistance of the parts, some authorities hold that in the case of operations carried out under aseptic conditions antiseptics should not be employed in dressing the wounds. On the other hand, authorities equally eminent point out that in consequence of the difficulties incidental to maintaining aseptic conditions in the after-treatment of surgical wounds in animals, the judicious employment of antiseptic solutions is indicated in order to avoid the risks of infection. As we are here concerned with the treatment of wounds under ordinary conditions and not under the facilities afforded by a well-equipped infirmary and carried out by practitioners specializing in surgical work, we may "make a long story short" by stating that the use of antiseptic agents is essential in the large majority of cases.

In the employment of antiseptics it is necessary to consider the object in view. Obviously, in the treatment of wounds of all kinds we should endeavour to prevent the entrance of pathogenic micro-organisms. Even in cases where we are aware that infection has already occurred, we have no right to increase it by carelessness in technique and neglect of precautions. We have already mentioned that it is the exception in ordinary veterinary practice to find that wounds are in an aseptic condition, and even if they are sterile at the outset they seldom remain so. The use of antiseptics is necessary with a view to diminishing the effects of already existing sepsis, or of destroying the micro-organisms which have gained entrance to the wound. Experience has shown that in ordinary veterinary practice attempts to treat wounds without the employment of antiseptics have not proved successful. Of course, discretion is necessary in the selection of antiseptics as regards their germicidal power and their freedom from irritating properties, while preference should be given to those which are comparatively non-poisonous and moderate in price.

Formerly it was held that infected wounds could not be rendered aseptic, but this view has been proved erroneous so far as human surgery is concerned, as by the adoption of a special method of irrigation designed by Carrel it has been proved by bacteriological examination of the secretions that the technique has succeeded in converting an infected into an aseptic wound. Except under special conditions this method is not practicable in treating wounds of animals, yet we are convinced that by means of efficient irrigation with a suitable antiseptic solution we can destroy virulent micro-organisms which have gained access to a wound, or we can prevent their development.

In the treatment of all classes of open wounds the same general rules apply with regard to the selection of an antiseptic agent and the avoidance of too strong solutions. The abuse of antiseptics, such as employing those possessing an irritant action, or using any agent in too concentrated solution, cannot be too severely condemned. Such an irrational practice defeats the object in view, as it causes irritation or destruction of the tissue cells and inhibits the natural process of vital resistance to the attacks of bacteria.

Much controversy has arisen amongst authorities in human surgery with reference to the necessity for antiseptics in wound treatment. Some claim that a simple saline solution (a solution of common salt in boiled water) is preferable to any antiseptic agent for irrigation of wounds where flushing is indicated. Experience in the use of both methods has taught us that in dealing with wounds in animals a non-irritating antiseptic is preferable to the saline solution. Moreover, as the majority of accidental wounds we meet with are infected prior to treatment being prescribed the necessity for antiseptics is quite obvious.

From time to time many antiseptic agents have been introduced, each claiming superiority over those already in use. These claims in many instances have proved to be imaginary, with the result that not a few practitioners have reverted to the time-honoured carbolic acid or its allies.

In recent years a solution of hypochlorite of soda has come into favour for general purposes in the cleansing and dressing of wounds, and in the form of Dakin's solution it has given excellent results. This solution, according to the modified formula of Daufresne, is prepared as follows :

Take 3½ ounces of chlorinated lime, put in a bottle capable of holding 4½ pints, and fill the bottle with cold water. Shake vigorously, and leave it to stand for 12 hours. In another bottle of similar capacity place 1 ounce and 5 drachms of dry carbonate of soda and 1 ounce and 2 drachms of bicarbonate of soda and fill the bottle with water. After 12 hours mix the contents of each bottle in a jar, shake well, let it stand, and after half an hour decant the clear liquid and filter through double filter-paper to obtain a perfectly clear product.

For further particulars on antiseptics, see article on "Surgical Technique."

In addition to the selection of a suitable antiseptic solution for the irrigation of wounds requiring this form of treatment there are other general principles, of importance in obtaining favourable results :

(*a*) The hair should be clipped closely, or preferably shaved, around the wound and its immediate vicinity. If this simple procedure be omitted the discharges from the wound cause matting of the hair, which forms a fresh nidus for infection.

(*b*) In dressing a wound care should be taken not to carry any of the discharge which may accumulate around the edges into the wound. Neglect of this simple precaution leads in many instances to a secondary infection of the wound. Not infrequently carelessness in this direction is most difficult to prevent, and in the case of ordinary attendants special stress has to be laid on the point when giving instructions as to after-treatment.

(*c*) *Rough Manipulation.*—The necessity for care in connection with the dressing of wounds cannot be too strongly emphasized. Ordinary attendants, not being acquainted with the natural mode of repair, do not appreciate the importance of avoiding damage to the tissues as exemplified by rough handling or attempts to cleanse the part by a process of scrubbing. Such irrational treatment retards healing and tends to increase the risk of leaving a permanent blemish. In using a syringe for the purpose of cleansing a wound by injecting the cavity with an antiseptic solution, care should be taken not to puncture healthy tissue, or to separate muscles with the nozzle of the instrument. Carelessness in this respect not infrequently leads to the spreading of infection to fresh tissues and the formation of pockets in which pus tends to collect.

(*d*) *Cleanliness of Surgical Dressings, Utensils, etc.*—We have already directed attention to neglect of surgical cleanliness as a source of infection in wounds. This is of much importance, especially as secondary infection resulting from this cause is to a large extent preventable by the exercise of simple precautions. It is necessary to emphasize the fact that both in surgical and accidental wounds secondary infection not infrequently is responsible for serious if not fatal results. By secondary infection is meant the entrance and development of pathogenic micro-organisms subsequent to the infliction of the wound. The chief sources are the surroundings of the patient, the manipulation and contaminated dressings associated with the faulty and careless technique of the ordinary attendant.

(*e*) *The Surroundings.*—Obviously it would be a Herculean task to render the stables usually met with in the country, and not infrequently in cities, sufficiently clean to prevent infection of wounds. Ventilation and drainage are usually of the most primitive character, while the floors, owing to an accumulation of dirt, constitute a veritable hotbed of infection. Under such conditions the progress of wound cases cannot be expected to be satisfactory. We have, however, to make the best of the surroundings and to render them as clean as possible.

Without doubt, provided the weather be suitable and circumstances permit, cases do better on pasture than in stables. This is exemplified by the successful results obtained in castration cases when the animals are left on grass as compared with those kept in stables. Open air, sunlight, and a clean grass field prove to be important attributes in connection with the efficient healing of wounds.

Classification of Wounds

Wounds may be classified into : (*a*) Closed wounds or contusions ; (*b*) open wounds.

(*a*) **Contusions.**—A contusion may be defined as a subcutaneous wound or injury due to external violence. The skin is not broken although it may be severely bruised in some instances, and in mild cases the connective tissue only is lacerated. In severe instances deeper structures are involved, such as muscles, tendons, nerves, or even bones. A familiar example of a mild type of contusion is the soft swelling resulting from a kick in the vicinity of the buttock, in which a cavity is formed by the laceration of the tissues, and contains serous fluid and blood-clots. As an example of the severe form we may mention the lesion resulting from an injury to the abdominal wall, in which the skin is intact but the underlying muscle is ruptured, constituting a ventral hernia. Another example of contusion is speedy-cut, found on the inner and lower aspect of the knee and produced when a horse strikes this part with the shoe of the opposite foot. The injury produced varies in degree from a soft swelling containing a blood-stained serous fluid to an acute, painful, inflammatory condition, associated with tense swelling, lameness, and sometimes considerable damage to the skin of the part, so that sloughing may follow.

It must be remembered that a contusion may be accompanied by an irregular wound of the skin and subcutaneous tissue, such as occurs when the wheel of a heavy vehicle passes over a horse's coronet. Also a wound may be of the type known as "contused and lacerated" when, in addition to the injuries of the muscular structures, the parts are also more or less bruised. A wound caused by the penetration of a shaft during a collision and one resulting from injury caused by a cow's horn are examples of contused-lacerated type. This type will be considered under "Lacerated Wounds."

Treatment.—This will depend on the extent of the injury. In the case of simple bruising of the tissues all that is necessary is rest and the frequent application of a lotion composed of equal parts of Goulard's extract and water. If the contusion occurs on a part to which a bandage can be affixed, a layer of cotton-wool soaked in the lotion may be applied.

In severe cases accompanied by pain and inflammation the best application is a thick layer of paste composed of kaolin and glycerine, or one of the patent preparations of this nature, such as thermofuge. The preparation is heated to a proper temperature before being applied, and the part is then covered with a layer of cotton-wool. Care should be taken not to continue this treatment too long, else disorganization of the skin may result.

In ordinary contusions the skin should never be incised except under special conditions, such as the presence of a large hæmatoma, or when a large artery has ruptured subcutaneously. In the case of a hæmatoma a free incision should be made at the lowest point so that efficient drainage may be secured. The contents of the sac are then carefully removed, and the cavity washed out with an antiseptic solution, and a tampon of double cyanide gauze inserted. Daily dressing is necessary. In spite of all precautions suppuration is likely to occur, and eventually healing takes place by granulation. Unless the procedure indicated be adopted a conspicuous permanent blemish is likely to result.

In some instances suppuration may ensue in a hæmatoma, probably from an invasion of bacteria through a minute lesion of the skin. This is observed in bumped knee and in some cases of "speedy-cut." A free incision should be made as early as possible, and the pus evacuated. The part is then treated on ordinary surgical principles.

Repeated contusions, such as result from long-continued "speedy-cutting" in horses with faulty action or formation of limbs, are likely to be followed by serious consequences. The skin covering the inside of the flexor tendons may undergo necrosis and sloughing, the subcutaneous tissue also being involved. In such cases prompt surgical treatment is essential, consisting of free incisions and frequent irrigation with an antiseptic solution.

When a large artery has been ruptured in hæmatoma a careful incision should be made through the skin, the blood-clots are then removed, and the vessel sought for and ligatured.

(*b*) **Open Wounds.**—In these the skin and subcutaneous tissue are severed, and, according to the extent and depth of the injury, other structures may also be involved. Open wounds are classified according to their mode of production and the nature of the injury as follows: (1) Incised; (2) lacerated; (3) lacerated and contused; (4) punctured; (5) poisoned; (6) gunshot or war wounds.

According to their condition as regards infection, wounds may be divided into (*a*) aseptic; (*b*) infected.

These various types require special technique as regards treatment, although the general principles already mentioned apply equally to all of them.

(1) **Incised Wounds.**—An incised wound is one caused by a sharp instrument or any article having a sharp edge. The tissues involved are cleanly divided, and bruising of the margins of the incision is absent. An incised wound varies in extent and depth according to the form or shape of the object producing it, the amount of force employed, and the nature of the tissues. Although a stone possessing a sharp edge may inflict an incised wound on a limb of a hunter while jumping a fence, such an injury is accompanied by a considerable degree of contusion, hence it does not properly come under the present heading.

In a deep incised wound various structures may be divided, such as muscles, blood-vessels, nerves, tendons, etc. Owing to arteries being cleanly divided, free hæmorrhage often occurs.

In operative surgery the wounds made by the surgeon are of the incised type. As regards the classification into aseptic and infected, every attempt is made to render surgical wounds free from infection at the time of operation and to maintain them in this condition. Obviously wounds caused by accident become more or less infected at their inception, owing to bacteria being conveyed by the object causing the injury.

Treatment.—In the treatment of incised wounds an attempt should be made to bring about primary union. This can only be accomplished by rendering the parts aseptic and suturing the edges of the wound. We have already pointed out the difficulties in connection with securing asepsis in the treatment of wounds in animals, and at the same time have shown that attempts in this direction are likely to be beneficial, as by enforcing surgical cleanliness as far as possible we shall avoid adding to the existing infection. We have also indicated the necessity for the judicious employment of antiseptics in general practice, owing to the difficulty, if not impossibility, of adopting aseptic methods with success.

The following remarks apply chiefly to accidental wounds, the after-treatment of surgical wounds being considered under a special section, viz. " Surgical Technique."

We will assume that the case is brought for treatment early, before any attempts at amateur surgery have been made. If severe bleeding is taking place, measures must be taken to arrest it at once. If the blood comes from a large vessel the latter must be secured by means of artery-forceps and a ligature applied. If the vessel is small, by simply twisting it with the forceps bleeding may be stopped. It is of importance to prevent bleeding, as the presence of blood in a wound forms a nidus for the development of bacteria.

The next step is to clip or, preferably, shave the hair closely around the edges of the wound and for some distance beyond it. This area is then painted with tincture of iodine.

The cleansing and disinfection of the interior of the wound is next carried out. A careful search should be made for foreign bodies, and if these are present they should be removed by means of dressing-forceps.

The initial disinfection of the wound is of vast importance, and any extra trouble involved by the technique will be amply repaid by the results. All accidental wounds are more or less infected, hence the necessity for thorough irrigation by means of a syringe and a suitable antiseptic solution. As regards the selection of an antiseptic, we have already drawn attention to the value of Dakin's solution. But a large number of agents are available for this purpose, and the selection is generally a matter of choice on the part of the practitioner.

The time-honoured carbolic acid (1 part to 40 of water) is still employed by some practitioners. Agents such as klondol and lysol are more reliable germicides and may be used in solution of 1 to 2 per cent.

After careful disinfection of the wound has been carried out, the application of sutures will be necessary.

Although the technique of suturing is regarded by the owners of animals as a very simple matter, yet in reality it is an art, and in order that favourable results may be obtained from its employment it is essential to direct attention to certain details. The various forms of sutures, their application and uses, will be described further on. Here we shall only refer to the uses of sutures in a general manner. In veterinary practice the chief use of sutures is to bring the edges of an incised wound into apposition, so that, if possible, healing by primary union may be brought about. Even when such a satisfactory result does not take place, the judicious employment of sutures assists healing by bringing the edges of the wound together, and also lessens the chance of blemishing.

But there are four important points to be considered in connection with suturing: (1) Before sutures are applied it is essential to disinfect the interior of the wound as thoroughly as possible. We quite admit that in ordinary conditions of practice it is rarely possible to render accidental wounds aseptic, but experience teaches that the more carefully the disinfection of wounds is carried out the less likely are unfortunate complications to result from the entrance of virulent bacteria. We are also confident that unless thorough disinfection is practised sutures do more harm than good, as they simply favour the development of micro-organisms by retaining the discharges; besides, they only retain their hold in the tissues for a very limited time, and by favouring sloughing of the edges of the wound they increase the chances of a resulting blemish.

(2) In large incised wounds when, owing to the mode of their production and the patient's surroundings, infection is tolerably certain, it is advisable, when circumstances permit, not to suture for some days or until thorough disinfection can be carried out. A prevalent idea exists that unless suturing is practised immediately it is of no value, but we know from experience that in a deeply infected wound it is of more importance to combat infection than to rely on early suturing.

(3) In suturing wounds efficient drainage should be provided. Neglect of this precaution gives rise to very unfortunate complications.

(4) Wounds in certain regions of the body, such as those of the head or the orbit, require great discrimination as regards the employment of sutures, and the most thorough disinfection is necessary. Not infrequently virulent micro-organisms seem to make such regions a seat of

predilection, as exemplified by the occurrence of erysipelas or malignant œdema in connection with wounds which appear to be trivial in extent. Generally speaking, it is preferable to avoid employing sutures in such cases, more especially when unskilled attendants have to be entrusted with the after-treatment.

As we shall point out later, lacerated and punctured wounds should seldom be sutured, and the same warning applies to wounds caused by bites. In the after-treatment of an incised wound that has been sutured, beyond making certain that sufficient drainage has been provided, nothing further is necessary. If, however, suppuration occurs and the edges of the wound become inflamed, it is essential to remove some of the sutures and to wash out the wound daily with an antiseptic solution.

As regards the application of surgical dressings and bandages, these are necessary in the case of wounds of the limbs, joints, etc. For information on this point the reader is referred to the article on "Surgical Technique."

Various forms of sutures. A few words on suture materials will be necessary before considering the technique of suturing. These may be classified into (*a*) absorbable and (*b*) non-absorbable. Of absorbable material catgut is the most familiar. When embedded in the tissues it is absorbed by the living body. Special preparation is necessary in order to render catgut sterile. The most reliable is known as Formalin Catgut, as it can be boiled without diminution of its tensile strength. Catgut may be employed for buried sutures and for superficial sutures when for any reason we wish to avoid subsequent removal. It is also suitable for suturing nerves, tendons, and muscles.

Non-absorbable material. Of this silk, in the form of twisted and braided silk is extensively employed for sutures.

Various substitutes for silk are on the market, and being soft in texture and sufficiently strong they form efficient suture materials. It is necessary to sterilize silk or its substitutes; this can be done by boiling for twenty minutes and then placing the material in an antiseptic solution, from which it can be taken as required. A suitable antiseptic solution is composed of one part of biniodide of mercury in 1000 parts of a 90 per cent alcohol, with the addition of 5 per cent of glycerine.

Silver wire was at one time a favourite material for suturing the skin, but it possesses no advantages over silk.

Silkworm gut, when sterilized by boiling, forms a very useful material for suturing wounds of the eyelids, etc.

Celluloid thread consists of fine linen fibres coated with celluloid. It is very useful for suturing small wounds and in canine surgery.

Linen thread may be employed for sutures in emergency cases when silk or other materials are not available. It is apt, however, to cut through the tissues.

Fine tape forms a very efficient suture material in the case of extensive wounds of the hip, back, etc., in horses and cattle.

For full details on the subject of suture material the reader is referred to the article on "Surgical Technique."

Here we may repeat that every precaution should be taken to avoid introducing infection during the suturing of wounds. The amateur does not recognize the importance of this point, and imagines that the chief aim should be to bring the edges of the wound together as quickly as possible, no attention being directed to the surgical cleanliness of the suture material, the needle, or the hands of the operator.

The Ordinary Interrupted Suture.—This is the form of suture most commonly employed. A number of distinct stitches are made, each separately fastened and complete in itself, and placed at intervals along the direction of the wound. Each suture is passed once through the divided structures and then tied so that the knot lies well to one side of the incision. One or more of the sutures can, if necessary, be removed without disturbing the remainder. In tying interrupted sutures care should be taken to avoid unnecessary tension. Although from the popular point of view the insertion of sutures is regarded as a very simple procedure, it is in reality one that requires skill and discrimination; neglect of technical details exerts a very unfavourable influence on the healing. The attempts of the amateur at suturing indicate that he does not appreciate the importance of providing proper drainage and of avoiding tension on the edges of the wound.

In inserting sutures it is essential to introduce the needle at a proper distance from the edge of the wound in order to secure a sufficient hold of the skin. The distance selected should vary according to the extent and depth of the wound. In small wounds the needle should be inserted close to the edges, while in those of large extent a firmer "hold" of the skin should be taken. The edges of the wound should be brought together accurately, so that no spaces will result, but it is of prime importance to arrange the sutures with a view to providing efficient drainage. The size and strength of the selected suture material should depend on the extent of the wound, the thickness of the skin, and the amount of strain to which the part is likely to be subjected. In extensive wounds in the region of the hip or quarter the material should be strong, and at the same time soft in texture so that it may not cut through the skin. A needle-holder is necessary in cases where the skin is tough and thick. Each suture may be tied as it is inserted, but in the case of wounds having a straight direction all the sutures may be first inserted and then tied. Care should be taken to see that the edges of the wound are not inverted at any point. In inserting sutures it is advisable to guard against infection from contamination of material by its coming into contact with the surrounding skin, etc. It is desirable to soak the suture material in a solution of biniodide of mercury.

With regard to the length of time that should elapse before sutures should be removed, this will depend on the condition of the wound. In the case of wounds that heal by primary union the suture may be removed about the seventh day. When, however, any sutures cut through one edge of the wound they should be removed without delay. The same remark applies when a wound suppurates, as sutures then do more harm than good. In removing sutures care should be taken to avoid drawing the outside part through the needle-track, as this would introduce infection. By means of a tissue-forceps each suture should be raised from the surface, cut with scissors, and then drawn outwards. In the case of vicious horses or unhandled animals, when large incised wounds have to be dealt with in the region of the quarter or hip, it may be necessary to cast the patient in order to apply sutures in a satisfactory manner. Not infrequently it proves the safest and most expeditious method for such cases and, besides, enables the practitioner to cleanse the wound thoroughly.

Sutures of Relaxation, or Tension Sutures, are useful in cases of wounds where there is considerable gaping or loss of substance, and some difficulty exists in bringing the edges of the wound together. The object is to transfer the tension from the healing margin to tissues further away, and thus relax the strain on the superficial sutures. Relaxation sutures are inserted at some distance from the margins of the wound and carried deeply through all the divided tissues, and emerging at points in the opposite side corresponding to the apertures of entry. Care should be taken not to draw them too tight. They are generally removed at the end of three or four days. Relaxation sutures are of special value in closing wounds of the abdominal region.

The Quilled Suture is seldom employed. A quill or a fine metal rod is passed through the loops on one side of the wound, the ends of the stitches being tied over a rod on the opposite side.

The Mattress Suture is a form of interrupted suture made by passing the needle transversely across the wound, and recrossing it at a short distance so as to leave a loop at one side and two ends at the other. The ends are then tied together.

The Twisted or Pin Suture is convenient in cases of emergency when needles and suture material are not at hand. It is formed by passing a pin deeply through the tissues and transfixing both sides of the wound. The margins are then brought together by twisting a piece of thread in a figure-of-eight form around the projecting ends of the pin. The pin is then shortened by cutting off the point with scissors. A pin-director is useful in making a pin-suture.

Continuous or Uninterrupted Sutures are those in which a single thread is employed for the purpose of making a series of consecutive stitches. They are seldom employed for suturing the skin, but are used in the form of buried sutures for uniting deeper structures and also for wounds of the hollow viscera. For a description of these sutures the reader is referred to the article on "Surgical Technique." One form of continuous suture, however, is worthy of mention here, namely *the subcuticular suture*, as it is especially useful in canine practice.

A fine straight needle and fine silkworm gut are employed. A grain of perforated shot is fixed on the tail of the suture close to its end to prevent its drawing through. The needle and suture are passed through the epidermis (or outer layer of skin) close to one end of the incision, and then traverse the corium (or deep layer of the skin) on each side alternately, and finally emerge through the epidermis at the other end of the wound. When the suture is drawn sufficiently tight the margins of the skin are approximated, and by means of another grain of perforated shot this end of the suture is also prevented from becoming loose. If perforated shot is not at hand, the ends of the suture may be fixed by means of a figure-of-eight knot. Of course, this suture is only suitable for aseptic wounds.[1]

(2) **Lacerated or Contused-lacerated Wounds.**—A lacerated wound may be described as one which is produced by a more or less blunt object, consequently the tissues are torn, including the skin. Not infrequently a pointed object may cause a lacerated wound if an animal rushes against it and then endeavours to free itself. A cow's horn is capable of causing an extensive laceration, while a sharp-pointed object, like a large hook, when caught in the tissues, may produce a very deep and lengthy wound. Again, it must be remembered that a wound in the vicinity of the shoulder or quarter caused by the shaft of a light car in a collision may give the

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[1] For illustrations of the various forms of suture the reader is referred to the article on "Surgical Technique."

appearance of a punctured wound externally, but there may be extensive laceration of the muscles in the deeper parts. Kicks, especially when inflicted by a horse shod with calkins, may in some cases cause extensive laceration, while barbed wire is capable of producing extraordinary damage to the tissues. Lacerated wounds are always associated with more or less contusion of the parts, a complication which adds materially to the gravity of such injuries; as sloughing of the tissues is apt to follow, and this increases the risk of septicæmia.

A very serious form of lacerated and contused wound is met with as the result of the wheel of a heavy vehicle passing over the coronet of a horse. In the hunting-field lacerated and contused wounds of the horse's limbs are of very common occurrence, more especially in a country like Ireland where ditches and loose stone-walls largely exist as fences. Cases arising from this cause will be considered later under the treatment of wounds according to their position.

Amongst the more serious and often fatal lacerated wounds are those caused by the shaft of a car or cart during a collision, as owing to the force of the impact the shaft may penetrate the thoracic or abdominal cavity, or may rupture a large blood-vessel, and cause death from hæmorrhage in a very short time.

Treatment.—Here it is advisable to discuss general principles of treatment as applied to lacerated and contused wounds. The special measures to be adopted will be considered under wounds of the various regions of the body.

Suppression of Hæmorrhage.—In lacerated wounds of moderate extent hæmorrhage, as a rule, is slight, because the blood-vessels are torn instead of being cut as in incised wounds. In the case of extensive lacerated wounds, however, hæmorrhage may be profuse, and if large blood-vessels be severed immediate surgical intervention is essential. Not infrequently in the case of deep wounds considerable difficulty will be experienced in locating and ligating the bleeding vessel. If the patient be unhandled, or a nervous, well-bred animal, the difficulty is increased, more especially in cases where it is necessary to enlarge the opening of the wound in order to secure the vessel. When the hæmorrhage comes from a wound in the vicinity of a fore or hind limb, the application of a tourniquet above the wound will control the bleeding until the artery can be secured. In an emergency an improvised tourniquet can be made by knotting a handkerchief around the limb, and inserting a stick between them and giving it a series of twists. Of course, a tourniquet can only be regarded as a temporary expedient, and must be released when the vessel is secured. Although firm plugging of the wound with pledgets of carbolized tow, soaked in a styptic such as compound tincture of benzoin, will succeed in the case of bleeding from vessels of moderate size, this treatment cannot be relied upon when it arises from a large artery, as there is considerable risk of recurrent hæmorrhage. Experience teaches that in such an instance, if owing to the opposition offered by the patient the vessel cannot be secured, the most advisable course is to insert provisionally a tampon of tow, then cast and secure the animal and take up the artery. With the horse in the recumbent position the procedure is greatly facilitated, and, if necessary, the opening of the wound can be enlarged in a safe manner. In the case of a deep-seated vessel it may be impossible to apply a ligature, especially when the tissues are of a dense character and the artery retracts. Under such conditions a large artery forceps is required, and when a good grip of the vessel is obtained the instrument can be left *in situ* for twenty-four hours or longer. For this purpose a most useful instrument is Schoemaker's artery-forceps or "Ligature Carrier," which carries the loop of the ligature in a groove on the point of one of the blades. When the vessel is secured the ligature can be tied with facility, and the operator can be certain that it does not enclose the point of the forceps. In the case of a large artery it is advisable to ligature both ends of the divided vessel, as owing to collateral circulation bleeding may take place from the proximal end.

When hæmorrhage has been controlled by plugging the wound with tow, care should be taken that the tampon is not removed too soon, as otherwise recurrent hæmorrhage may follow and prove serious. If the tampon be antiseptic, it can be allowed to remain in place for about twenty-four hours, the length of time depending on the serious character or otherwise of the bleeding.

Having succeeded in arresting hæmorrhage, we next make a careful examination of the wound and proceed to—

Cleansing, Disinfecting, and providing efficient Drainage.—On these details successful results depend to a large extent. The extra time occupied in this part of treatment will be repaid by the prevention of complications, more rapid healing, and considerable limitation of blemishing.

The first step is to remove all necrotic or bruised tissue. This can be effected by means of a tissue forceps and sharp scissors. The wound is then irrigated with an antiseptic solution, and a careful search made for foreign bodies, which, if found, should be removed. In wounds of certain regions portions of bone may be detected, and should be extracted at once. Neglect to search for foreign bodies is often responsible for unsatisfactory results such as sinus formation. Without doubt the presence of a foreign body in a wound renders the animal more liable to become infected with tetanus.

The next step is to provide proper drainage, and in the case of extensive wounds, such as those caused by a cart shaft, considerable ingenuity will be required in order to render this procedure effective. By observing the course and direction taken by the fluid injected into the wound a fair idea will be gained of the position for making the necessary counter-openings. Diligent search should be made for "pockets" in any part of the wound, and if present these must be laid open, as otherwise they would act as reservoirs for pus. Similar remarks apply to torn fasciæ resulting in the formation of a *cul-de-sac*. Not infrequently there may be considerable difficulty in securing efficient drainage owing to the direction of the wound, and in making the necessary counter-openings a marked degree of surgical skill is required. It is generally necessary to cast nervous or vicious horses in order to carry out the procedure with safety and efficiency. It is important to point out that, unless proper drainage be provided, the most assiduous irrigation is likely to fail in preventing serious complications. For irrigation of extensive wounds the most suitable apparatus is a continuous flow-pump provided with rubber tubing. In summer time the ordinary hose-pipe and cold-water tap prove efficient for the preliminary daily flushing, and the irrigation is completed by washing out with an antiseptic solution. But in winter weather cold-water flushing is not advisable. Recent experience has proved that the most suitable antiseptic agent is Dakin's solution.

In irrigating a wound care should be taken not to injure the tissues by rough manipulation, nor to make fresh openings between healthy muscles, as such irrational handling would start new centres of infection. In amateur treatment errors of this kind are not infrequently committed, especially when the irrigating tube is furnished with a metal or wooden nozzle.

Sutures.—In the majority of lacerated wounds sutures are not required. Cases occur, however, in which sutures employed with discretion assist in promoting healing by bringing the edges of the wound together at its two extremities, when the tissues are widely separated. Thus in large wounds in the vicinity of the hip and quarter, the insertion of a few interrupted sutures is often indicated. Care should be taken, however, to ensure that drainage is not interfered with, and if there be evidence that pus is prevented from escaping, the sutures should be removed. In most instances suturing lacerated wounds can only be relied on to keep the parts together for a short time, as under ordinary conditions suppuration is inevitable and the stitches slough out. The common mistake made by amateurs in connection with wounds of this nature is to apply sutures in a similar manner to that adopted for incised wounds. The necessity for drainage is not appreciated, and serious complications are apt to result from preventing the escape of discharges.

As regards the after-treatment of lacerated wounds, one must be guided by the progress attained and the occurrence or not of complications. Irrigation must be practised as long as the discharge of pus continues, and during the course of treatment it may be necessary to provide additional drainage. Complications will be considered under a separate heading.

In country practice the difficulties in the way of ensuring ordinary cleanliness are enormous, hence it is usually necessary to prescribe a dressing which is likely to overcome the inevitable infection resulting from the manipulations of the attendant, and from the patient's surroundings. A useful all-round dressing is composed of creosote ʒij., oil of turpentine ℥iv., and olive oil Oj. This possesses the advantage of warding flies from the wound—a most important point during warm weather.

(3) **Punctured Wounds.**—Wounds of this type are very common in veterinary practice. They may be caused by any form of sharp or blunt-pointed body, and are characterized by an insignificant surface opening and considerable depth, so that the serious nature of the lesion is apt to be overlooked by the layman. Much damage may be caused to deep-seated tissues, and, owing to the fact that often efficient drainage is difficult to provide, serious complications are likely to ensue. As examples of this type of wound may be mentioned punctures of the foot due to gathered nails, punctures of the limbs in hunters due to thorns, sharp projecting spicules of stone or sharp branches of furze (gorse), and a stab of the fetlock or pastern from a stable fork. Punctured wounds of joints or of the chest or abdominal cavity are especially dangerous, and will be discussed under "Wounds of Special Regions."

Another important feature in connection with punctured wounds is the frequency with which a foreign body may be present without being detected. Such an occurrence prevents the wound healing, and not infrequently leads to the formation of a sinus. Again, owing to the injury inflicted on deep-seated structures, a portion of necrosed tissue may be imprisoned in the depth of the wound and induce a chronic discharge of pus.

Treatment.—The general principles of treatment will be considered here. In cases where a blood-vessel has been punctured the first indication is to arrest the bleeding. Owing to the small size of the orifice of the wound it may be necessary to enlarge it in order to take up the vessel and apply a ligature. When the artery is of small size, hæmorrhage can be controlled by inserting a plug of tow soaked in compound tincture of benzoin.

The next step is to ascertain the direction and depth of the wound by the careful use of a probe, and also by the finger. Efficient drainage must then be provided by enlarging the wound and making a dependent orifice. If the direction of the wound be downwards there may be considerable difficulty in carrying out this procedure, but by acting on mechanical principles, and observing the manner in which fluid injected into the wound escapes therefrom, suitable drainage can generally be provided.

A careful search for foreign bodies must next be made; neglect of this precaution has on very many occasions been responsible for unfortunate results. A thorn, a splinter of wood, a spicule of bone or a bit of flint may easily be overlooked, hence the importance of thorough exploration. Irrigation with an antiseptic solution is then carried out, and the wound is treated in a similar manner to that advised for lacerated wounds.

In the case of a very deep wound it is advisable to plug loosely with double cyanide gauze soaked in Dakin's solution, and to remove this daily. Not infrequently there is a tendency for healing to proceed in the superficial part of the wound, while the deep region continues to suppurate. By the judicious use of gauze plugging such an undesirable condition can be avoided, and the orifice can be kept patent until healing by granulation has occurred in the deep part of the wound.

As punctured wounds are most liable to be followed by tetanus, it is always advisable to administer a dose of antitetanic serum as early as possible.

In valuable animals, when there is a suspicion of the existence in a wound of a foreign body which cannot be detected by the probe or the finger it is advisable to bring radiography to our assistance.

Poisoned Wounds.—Under this heading some authors describe various wounds, including those infected by virulent micro-organisms. The latter will be dealt with in the section entitled "Wound Complications."

Bites inflicted by a dog may be included with poisoned wounds, as unless early surgical treatment is adopted a serious septic condition is likely to result. Usually another dog is the victim, but occasionally a vicious dog attacks a horse and inflicts wounds of the lips or of the limbs. In the case of a large dog the canine teeth may cause deep punctured wounds, which in the limbs may infect tendon sheaths and lead to extensive sloughing of the skin and underlying structures. In the treatment of such wounds sutures must on no account be employed; efficient drainage should be provided by the judicious use of the knife, and the part should be thoroughly irrigated with an antiseptic solution, and a cataplasm of thermofuge applied thick and hot.

If septicæmia is threatening it is advisable to administer a dose of polyvalent anti-streptococcic serum subcutaneously; this is a valuable auxiliary to surgical treatment.

Stings of insects, such as bees or wasps, may cause serious results if an animal be attacked by a swarm of these and the part involved be the region of the throat, as extensive swelling of the pharynx or tongue may result and also œdema of the glottis. In such a case a tracheotomy tube must be inserted at once so as to prevent asphyxia. In milder cases an alkaline lotion, such as a solution of bicarbonate of soda in water or a very dilute solution of liquor ammoniæ, may be applied. Certain flies capable of biting may after feeding on putrid material cause a serious form of septic inflammation in the bitten part. The treatment consists in applying a cataplasm of thermofuge, and when evidence of pus formation is manifested, a free incision should be made into the part.

Snake Bites are not encountered in the British Isles, as the only venomous reptile met with is the common adder, and the poison which it is capable of conveying with its bite is not of sufficient virulence to prove serious.

But in India and other countries where poisonous snakes are found, fatalities are common. In the treatment of such cases, if the bite be situated on a limb, a tight ligature should be applied above the wound so as to prevent absorption of the virus. The part should be laid open with a knife, the tissues excised, and permanganate of potash applied. If available, Fraser's antivenene should be injected subcutaneously. Collapse is to be combated by the administration of stimulants and hypodermic injections of strychnine.

Gunshot Wounds.—In civil practice this type of wound is rarely met with except in dogs, as the result of accidents during shooting or of the act of malicious persons. In the case of wounds occurring in warfare, when treatment is deemed to give a fair prospect of a return to utility, the principles are similar to those advised in connection with lacerated and contused or punctured wounds. The arrest of hæmorrhage is the first consideration, then the removal of foreign bodies if present and of all bruised and loose tissues; the provision of drainage, followed by frequent irrigation with Dakin's solution. The question of applying dressings of gauze and cotton-wool, etc., must be left to the discretion of the surgeon.

In the dog the damage caused by shot will depend on the range at which the gun is fired. If discharged close to the animal extensive destruction of tissues will result, and probably render the case hopeless. If at long range, the shot is scattered and may enter the skin and subcutaneous tissue and can be detected by palpation. If not interfered with, the grains of shot gradually find their way to the surface of the skin and can be removed with facility. Not uncommonly they reach the surface a long distance from the seat of entrance.

Here we may remark that in the case of either bullet or shot, if no important structures are injured, the foreign body may remain *in situ* indefinitely without inducing suppuration.

Complications or Sequelæ of Wounds.—These are of great importance, not only from the therapeutic aspect but also from the preventive point of view. As infection is responsible for the majority of these unfortunate occurrences, the necessity for attention to surgical cleanliness and to the judicious employment of antiseptics will be readily understood.

Recurrent, Intermediate or Reactionary Hæmorrhage.—We have already referred to the suppression of hæmorrhage as the primary step in the treatment of all wounds associated with bleeding. Here attention must be directed to hæmorrhage which recurs within twenty-four hours after the infliction of a wound, and this is termed recurrent, intermediate, or reactionary, and occurs subsequent to primary treatment.

Various factors are responsible for this unfortunate occurrence, such as (*a*) the slipping or loosening of a ligature owing to defective application, such as tying a "granny knot"[1] instead of a "reef" or "surgical" knot, or from including within the grasp of the ligature other structures as well as the artery; (*b*) in cases where plugging of the wound has been resorted to, too early removal of the material, *i.e.* before the coagula in the divided vessels have become sufficiently firm to withstand the blood-pressure; (*c*) exercise or excitement subsequent to the cessation of hæmorrhage may, by increasing blood-pressure, disturb the coagula in vessels which have not been ligatured.

Secondary Hæmorrhage.—This term is applied to bleeding from wounds after the lapse of twenty-four hours. The following factors may be responsible: (*a*) Infection of the obstructing coagula, which break down under the influence of bacterial action, an ulcerative form of arteritis which may bring about softening of an absorbable ligature with weakening of the vessel wall, and thus contribute to the production of secondary hæmorrhage; (*b*) the ligature may be composed of material which is too readily absorbed; (*c*) a vessel may be exposed in its continuity and, owing to tension on its walls due to movements of the animal, it may rupture.

Treatment.—This form of hæmorrhage is more difficult to control than the recurrent, as the walls of the vessels may be in an unhealthy condition and tend to rupture while being secured. In bleeding from a large artery every effort should be made to apply a ligature to the vessel, as plugging the wound is seldom satisfactory. The prevention of secondary hæmorrhage consists in careful attention to the suppression of primary bleeding, and in applying proper ligatures to every artery within reach. When a vessel exposed in a wound is likely to be subjected to tension it should be ligatured. Plugging a wound with tow or cotton-wool cannot be relied on in hæmorrhage from large vessels, and should only be practised when it is impossible to secure them with artery forceps.

In cases where collapse seems imminent owing to loss of blood, stimulants are indicated. The hypodermic injection of two drachms of solution of adrenalin (1 to 1000), with half a grain of atropine sulphate, often gives excellent results. The patient should be warmly clothed, and bandages applied to the limbs.

Cellulitis is a spreading inflammation of the subcutaneous or cellular connective tissues, with a tendency to terminate in suppuration and necrosis. It varies in degree and extent, and originates from the presence of various bacteria in the wound. The more severe types of cellulitis are caused by the *Streptococcus pyogenes*, and not infrequently the lesions produced resemble those of erysipelas. The milder forms depend on *Staphylococcus pyogenes aureus* or *albus*.

The symptoms observed vary according to the severity of the attack and the virulence of the causative micro-organisms. The lips of the wound and the tissues in the vicinity become swollen, hot, and painful. If occurring in a limb the swelling extends upwards, the superficial lymphatic vessels become prominent, and marked lameness is observed.

In severe cases constitutional symptoms are present, such as fever, depression, loss of appetite, etc., due to absorption of toxins by the general circulation. Suppuration occurs under the skin, with sloughing of the cellular tissue. The skin in parts becomes softened and gives way, so that a number of openings are produced. In severe cases associated with deep wounds the pus may extend between the muscles, and necrosis of the muscular tissue may result. General septicæmia may set in unless prompt surgical treatment be adopted.

Treatment.—In mild cases, attention to efficient drainage of the wound and thorough irrigation with an antiseptic solution will usually prove successful. If severe pain be present a hot cataplasm of thermofuge may be applied for a few days, but discretion is necessary, as such applications tend to produce softening and disintegration of the skin. In severe cases free incisions should be made into the tense tissues, in addition to providing proper drainage for the wound. Polyvalent anti-streptococcic serum administered by subcutaneous injection gives excellent results in some cases, and the injection may be repeated every second day until improvement occurs. When suppuration is observed in the vicinity of the wound, free incisions should be made and the parts thoroughly irrigated with antiseptic solutions.

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[1] For a description and illustration of these knots the reader is referred to the article on "Surgical Technique."

Erysipelas.—As already remarked, the borderline between severe cellulitis and erysipelas is not clearly defined in many cases. The causal micro-organism of erysipelas according to some authorities is the *Streptococcus erysipelatus*, but it is admitted that its microscopical characters cannot be differentiated from those of ordinary *Streptococcus pyogenes* occurring in cellulitis. The infective nature of erysipelas makes, however, a striking difference between the two affections.

Erysipelas cannot be described as common in animals, but its serious nature, especially when associated with wounds in the vicinity of the head or orbit, must be pointed out. Erysipelas is characterized by a spreading inflammation of the skin and subcutaneous tissue, with the local formation of toxins, which being absorbed are to a large extent the cause of the marked constitutional disturbance and fever which accompany this disease. The streptococci responsible for the affection are widely distributed and may become attached to litter, the walls of buildings in which affected animals are housed, and may be carried by the hands or clothes of attendants, and thus infect wounds or abrasions.

The alterations produced in a wound infected with erysipelas are as follows: Marked swelling of the structures in the vicinity of the wound and extending to a considerable distance beyond it. As the swelling extends it is limited by a broad, sharply defined, slightly raised and infiltrated margin of skin. The discharge from the wound is amber-coloured in some cases. In others, diffuse suppuration occurs; areas of skin lose their vitality and fall off by sloughing and there is a discharge of watery sanguineous pus containing shreds of lymph and debris of broken-down tissues. Serious constitutional disturbance is present, and may be accompanied by extensive necrosis of the skin and underlying tissues. Death may follow from exhaustion, septicæmia, or other complications.

Treatment.—Patients that are in high condition (sthenic) should be given a moderate dose of purgative medicine. The judicious administration of aconite is indicated when pain and marked constitutional disturbance are present. Attention should be directed to the condition of the wound and free drainage provided. Thorough irrigation with an antiseptic solution should be carried out.

When there is evidence of suppuration under the skin, free incisions should be made. Ichthyol ointment combined with extract of belladonna and glycerine should be applied around the wound.

A polyvalent anti-streptococcic serum should be administered subcutaneously on the appearance of the first evidence of the disease and repeated daily until improvement takes place.

Malignant Œdema is also known as spreading traumatic gangrene, and is one of the most serious and fatal of wound complications. The micro-organism on which it depends is the *bacillus of malignant œdema.* Although not a common condition in animals, yet it occurs sufficiently frequently to merit brief consideration here. The symptoms produced are a very acute cellulitis accompanied by general septicæmia. The surface of the wound becomes covered with sloughs, the tissues in the vicinity are much swollen, and the skin crepitates on pressure, owing to the presence of gases in the underlying structures. The process spreads rapidly and extensive gangrene of the tissues supervenes. Death occurs from general blood-poisoning.

The majority of cases prove fatal. If the patient be seen early, free incisions into the affected tissues should be made, and constant irrigation with an antiseptic solution carried out. For further details see "Malignant Œdema."

Irritative Fever.—This term is sometimes applied to the acute febrile condition associated with septic wounds of joints or tendons, or any surgical lesion of the limb or foot accompanied by great pain. The symptoms, which depend on infection, nerve irritation, and probably absorption of toxins, consist of elevation of temperature, quick pulse, accelerated respiration, loss of appetite, sweating, constant movement of the affected limb, which is unable to bear weight; after some time emaciation sets in and gradual exhaustion; in some instances the animal goes down and struggles in a convulsive manner. Unless early and successful treatment of the lesion is possible, such cases usually terminate fatally, or are destroyed as incurable. If treatment be attempted, the indications are to relieve pain and to quiet the irritability of the nervous system. These are accomplished by prescribing chloral hydrate.

Tetanus is one of the most serious complications of wounds. For full information the reader is referred to the special article on the subject. Here we may point out that tetanus arises from infection of the wound with the *Bacillus tetani*, and that since antiseptic treatment has become general the disease is not so frequently encountered in surgical practice. The prevention of the affection by the administration of antitetanic serum is well known, and in treating wounds in valuable horses the practitioner should administer this serum as early as possible. Moreover, the very high mortality of tetanus accentuates the necessity for the timeous employment of this serum.

Sinus Formation.—In deep punctured wounds, more especially in certain regions such as the area between the forearm and the sternum, the ribs, the shoulder, the anterior tibial region and the coronet, sinus formation is a very troublesome sequel. A sinus is a narrow track with a smooth lining and extending deeply into the tissues. The orifice is often depressed and continuous with the skin, and there is a constant discharge of pus, so that healing cannot take place until surgical treatment is adopted. On exploration considerable tension is present, and if a tampon of gauze be inserted it is forced outwards after a short time.

In favourable cases the walls of the sinus are lined with granulation, and if sufficient drainage be provided healing takes place under ordinary antiseptic treatment. But there are certain causes which are responsible for the non-closure of a sinus. These include the presence of a foreign body in the depth of the wound, such as a ligature, a fragment of diseased cartilage or bone, a splinter of wood, a thorn, or a piece of stone or iron. Insufficient drainage associated with tension in the wound also tends to produce sinus formation. Constant movement of the part is also a causative factor, as it prevents healing, as happens with wounds situated between the fore extremity and the trunk.

Treatment.—In dealing with a sinus the first essential is to enlarge the opening so as to enable a search to be made for a foreign body, and also to provide drainage. The next procedure is to examine the walls of the sinus, and if lined by a smooth membrane this should be removed by careful scraping with a sharp curette.

Daily irrigation with an antiseptic solution is then carried out, followed by plugging with antiseptic gauze, and healing not infrequently results within a reasonable time.

But cases occur in which, owing to the direction of the sinus or its situation, it is impossible to reach its limit, or to provide proper drainage. In such instances success is often obtained by injecting daily a strong solution of sulphate of zinc (1 part of zinc sulphate to 4 parts of water). This causes a removal of the lining of the sinus, and healing then takes place throughout the track of the sinus.

For sinuses which do not extend deeply the application of a blister to the part will often succeed in bringing about closure.

Wounds of Special Regions

Wounds of Joints. Open Joint. Traumatic Arthritis. Open Arthritis.—A wound which in other regions of the body would be considered as comparatively trivial, is likely to have serious if not disastrous results if it penetrates the capsule of a joint. As compared with a similar injury in man, open joint in the horse is always a condition of the greatest gravity, owing to the following reasons: (*a*) The difficulty of preventing infection; moreover, in the majority of instances the part is infected before professional attendance is sought. (*b*) The impossibility of securing and maintaining perfect rest of the part. Owing to the acute pain of the joint the animal is constantly moving the limb, and thus interferes with the process of repair. (*c*) The tendency to the formation of a stiff or immovable joint. This sequel is unfortunately very common and is the cause of much disappointment after a long, tedious, and expensive course of treatment. Obviously, a horse with a stiff or immovable joint when the articulation is one in which free movement is essential is of little value. Not uncommonly complications set in during the course of the case, such as a high degree of fever, accompanied by extreme pain, abscess formation, emaciation, nervous symptoms, and exhaustion, which render the destruction of the animal a necessity. Here it is desirable to point out that the injury or wound *per se* is not the main factor in causing the serious effects associated with an open joint. The extensive lesions produced in the joint and the severe constitutional symptoms observed are in reality due to infection, either at the time of accident or subsequently, owing to unfavourable surroundings and the impossibility of carrying out aseptic treatment.

If infection could be eliminated from an open joint the effects of the injury would be limited to simple inflammation of the synovial membrane and the wound in the overlying structures, both of which conditions would recover under suitable treatment. When, however, as is usually the case in veterinary practice, micro-organisms have entered the joint, an acute septic arthritis (septic inflammation of the joint) occurs, which leads to destruction and disintegration of the joint. It is necessary to state, however, that occasionally wounds of joints in animals escape serious infection, and provided suitable treatment be adopted, successful results are obtained.

In order to gain an accurate idea of the pathological changes produced in a joint by a wound associated with infection it is necessary to be acquainted with the anatomy of the structure in a general way. Usually the joints which are liable to suffer from injuries leading to an open arthritis are those of the limbs.

We shall point out briefly the structures entering into a joint which possesses free movement (termed a diarthrodial joint); the modifications occurring in certain articulations will be considered later, when they are of sufficient surgical importance to merit attention.

A joint is composed of the articular ends of the bones which enter into its formation. The articular surfaces are covered by a thin layer of what is known as hyaline cartilage. The bones forming the joint are kept in apposition by *binding* or *restraining* ligaments which pass from one bone to the other. A *capsular* ligament encloses the cavity of the joint and gives support to the synovial membrane which lines its internal surface. The synovial membrane secretes synovia which is popularly known as " joint-oil " and serves to lubricate the joint.

Normal synovia is a glairy, straw-coloured fluid, which is somewhat oily in appearance but in reality only contains traces of fat. Its glairy character is due to the presence of mucin and albumin.

The synovial membrane has a basis of vascular connective tissue which is adherent to the inner surface of the capsular ligament. At the margin of the articular surfaces this connective tissue blends with the articular cartilage. Here also the synovial membrane may take the form of finger-like or villous processes projecting into the joint cavity; these serve to distribute the synovia in the joint.

Causes of Open Joints.—Penetrating wounds arising from kicks, a stab from a stable fork, a puncture from barbed wire, injuries in the hunting field such as wounds from a sharp projecting stone, or from a pointed branch of gorse; falls, such as result from stumbling, where a horse's knee comes in contact with a sharp stone and opens one of the joints of the knee. The coffin-joint may be punctured by a picked-up nail. In some instances the injury may be inflicted at some distance from the joint and the septic inflammation may extend upwards by way of the tendon sheaths and reach the synovial membrane, as in the case of a septic wound of the forearm ultimately involving the elbow-joint.

Again, a wound directly over a joint may not primarily puncture the capsular ligament, but should sloughing occur the articulation becomes involved. Meddlesome probing of a wound over a joint not infrequently leads to the capsule being opened.

Morbid Alterations as the result of Open Joint.—When infection has gained entranceto a joint, serious structural alterations are produced. The synovial membrane becomes acutely inflamed, the primary effect being to check the secretion of synovia; but this is soon followed by exudation or increased secretion, which is of a thin, turbid character and rapidly becomes purulent. During the movement of the joint the altered synovia may be expelled forcibly from the wound in a fine stream, and even while at rest it is discharged and coagulates around the lips of the wound. The entire joint becomes tense, swollen, and extremely painful, and little or no weight can be borne by the limb. The suppurative process extends deeply into the joint, and abscesses may also form in the vicinity of the wound. The ligaments become sodden and relaxed, and ultimately the synovial membrane is replaced by granulation tissue. The articular cartilages become softened, eroded, and finally destroyed. Suppuration extends beneath these cartilages and separates them from the bones, and portions of the necrosed cartilage may be found free within the joint. The ends of the bones forming the joint undergo acute ostitis (inflammation of bone) resulting in the transformation of the medulla into granulation tissue and absorption of the bony cancelli. The ultimate result, should the patient survive, is anchylosis of the articulation, *i.e.* the union of the opposing surfaces of the bone with immobility of the joint.

Symptoms.—In addition to the local symptoms just mentioned there are marked constitutional disturbances and much pain, which seems out of all proportion to the extent of the injury. As a rule these symptoms are not manifested immediately after the infliction of the wound, but are usually deferred until the second or third day, or even later, and their severity depends on the degree of infection that occurs. When open joint is complicated by fracture of one of the bones forming the articulation the pain and lameness are observed shortly after the accident. The pulse is increased in frequency and soon assumes a hard and wiry character, respiration is much accelerated, and the temperature may rise to 104° or 105°. Muscular tremors and sweating are observed in severe cases, also loss of appetite. Owing to the severe and continuous pain there is constant movement of the limb. Unless relief be obtained and the suppurative process can be checked by treatment the animal gradually becomes exhausted, or various complications set in and prove fatal. Even if one is so fortunate as to check the discharge of synovia and to obtain healing by granulation, it not infrequently happens that anchylosis of the joint results and renders the horse of little value.

Diagnosis.—This is based on the situation of the wound, on the discharge of synovia, and on the constitutional disturbance. In severe cases the opening into the joint is plainly visible. It must be remembered that an infected open synovial bursa in the vicinity of a joint may give rise to considerable pain and lameness, with discharge of synovia, hence discretion is necessary in forming a diagnosis, especially as exploration of the part with a probe cannot be practised without extreme danger to the patient.

Prognosis.—In many instances it is extremely difficult to foretell the result of open joint. The presence of blood in the discharge is an indication that the vascular ends of the bone are exposed and that anchylosis is likely to result. Should this take place in a joint where free movement is essential to the utility of the horse, the outlook is distinctly unfavourable. If one of the principal knee-joints or the true hock-joint be exposed by the injury, the chances of a useful recovery are very remote. If early treatment be carried out, and if the joint involved be one in which free movement is not essential to locomotion, the prognosis is more favourable. But under the best conditions open joint in veterinary patients must be regarded as a very serious injury, because of the difficulty of maintaining asepsis and preventing movement of the articulation.

Treatment.—Various methods of treatment have been advocated from time to time for open joint, and if we are to accept the views and statistics of some practitioners as correct, we can only assume that they have been singularly fortunate in the cases they have treated, or that the patients have possessed marked powers of resistance to pathogenic micro-organisms which have gained entrance to a joint. It is customary to discuss treatment under two headings, viz. (*a*) cases in which infection has not taken place; and (*b*) cases which are already infected.

With regard to non-infected cases we must point out that even if the penetrating wound were inflicted by an aseptic object—a very rare occurrence—the probability is that infection would be carried inwards from the skin. The instructions to suture the wound after cleansing it, and to apply a dressing of iodoform collodion, etc., so as to seal the part, are ideal in theory, but the difficulty in practice is to ascertain at this stage whether the interior of the joint is aseptic or infected. If, as usually happens, infection has already occurred, the practice of sealing the wound is likely to do more harm than good.

Experience has taught that, after removal of the hair around the wound and carefully cleansing the part with an antiseptic solution and removing any foreign bodies present, the best treatment is to place the animal in slings and to apply a blister to the joint. The blister may be composed of cantharides (1 part to 8 of lard) or of biniodide of mercury (1 part to 8 of lard). Some practitioners prefer to irrigate the part continuously with cold water (by attaching a rubber pipe connected with a barrel of water above the wound) and claim good results, but this treatment has not proved successful in our hands. In cases where suppuration has occurred—and we may remark that these will form the large majority—drainage should be provided if necessary, and the joint cavity should be carefully washed out with an antiseptic solution such as one composed of corrosive sublimate 1 part, water 1000 parts. After this is carried out, a blister should be applied to the whole surface of the joint. Experience has proved that the counter-irritant relieves pain, limits movement, causes approximation of the lips of the wound, and tends to stimulate reparative action.

The coagulum of synovia which forms on the lips of the wound should not be removed. If, in spite of this treatment, abscesses form in the vicinity of the joint, the discharge continues and is blood-stained, and the constitutional disturbance shows no signs of abatement, and especially if the joint is one in which free movement is essential to utility, the case will not repay further treatment and destruction of the animal is advisable.

Of late years American practitioners claim success from adopting treatment which differs from that just mentioned. Frost (*American Journal of Veterinary Medicine*) shaves the hair from the area surrounding the wound thoroughly, and injects into the joint cavity 1 part of Lugol's solution of iodine in 4 parts of glycerine two or three times a day, using sufficient to fill the joint capsule (Lugol's solution of iodine is composed of iodine, 1 part; potassium iodide, 3 parts; water, 40 parts).

In the case of open joints where bandages can be applied, a dressing composed of antiseptic gauze should be employed.

Steffen (*Special Equine Therapy*) advises, after thoroughly cleaning the wound, irrigation of the joint cavity for at least ten minutes with a solution of corrosive sublimate (1 part of sublimate to 3000 of water) at body temperature. This is followed by irrigation with physiological salt solution. The irrigations are continued until the fluid returns clear and free from pus, flakes, etc.

The interior of the joint is then injected with the following preparation: Biniodide of mercury, ½ ounce; pure olive oil, 4 ounces; mix and shake before using.

This amount is injected slowly, and then the entire joint is enveloped in cotton-wool and a suitable bandage applied, or other retaining appliance in cases where bandaging is not practicable. The dressing is allowed to remain in place for two weeks. Steffen claims that in nine out of ten cases a complete cure will have been effected when the dressing is removed at the end of the period mentioned, and in rare instances only will it be necessary to repeat the treatment.

Wounds of the Lips.—Falls on hard ground, bites, kicks, tears from nails fixed in the vicinity of the manger. Bruising of the lips may be produced by the first three of the factors mentioned, and also by the rough and severe application of a twitch.

Lacerated wounds vary in extent and depth, and in some instances the lip may be "split," so that the internal mucous surface is severed as well as the skin.

Treatment.—Owing to the great mobility of the lips in the horse, and the fact that during prehension of food contamination of the wound is inevitable, considerable difficulty is often experienced in securing satisfactory healing. Conservative surgery should, however, be the rule so as to avoid permanent blemish. The general principles of wound treatment should be applied, viz. the removal of loose shreds of tissue, thorough cleansing with an antiseptic solution, and the employment of interrupted sutures to bring the edges of the wound together. Some practitioners prefer pin-sutures, as they tend to support the wound edges and are less likely to be disturbed by the movement of the lip. In cases where the edges of the wound have become dry owing to delay in treatment, they should be freshened by gentle scraping with a knife prior to suturing. When the lip is split through it is sometimes necessary to apply sutures to the internal mucous surface as well as to the external wound. Keeping the animal on sloppy food is advisable in order to limit the movement of the lips as much as possible.

Wounds of the Cheeks.—The most troublesome of these are deep wounds in the corner of the mouth, with severing of the mucous membrane and lengthening of the opening of the mouth so that some of the molar teeth may be exposed. Unless healing can be brought about a serious blemish results, which interferes with feeding and drinking.

Treatment.—The lips of the wound should be thoroughly cleansed and freshened. Deep sutures are inserted, first through the internal or mucous surface, and then another layer through the skin and underlying tissues. The suture material should be sufficiently strong yet soft in texture. The horse should be fed on milk and gruel until healing takes place. If the sutures slough out, fresh suturing should be attempted, and may prove successful. We have seen a case in a foal in which two attempts had failed and the third brought about satisfactory healing.

Other wounds of the cheek are to be treated on ordinary surgical principles.

Stenson's duct (the duct of the parotid gland) may be divided as the result of a punctured wound of the cheek in the vicinity of the third upper molar tooth, and salivary fistula may follow. For the treatment of this condition the reader is referred to the special article on salivary fistula.

Wounds of the internal surface or mucous membrane of the cheeks are common as the result of contact with the sharp edges of the molar teeth during mastication. They heal rapidly when the teeth receive surgical attention, *i.e.* removal of the sharp edges by means of the tooth rasp.

Wounds of the Nostril.—These are usually caused by the horse catching the nostril on a projecting hook or nail in the stable, and occasionally result from the bite of another horse. A common injury is a lacerated wound which lays open the false nostril. The cartilaginous portion of the nostril is sometimes wounded and may prove a troublesome condition owing to difficulty in healing and the danger of stenosis (narrowing) of the nostril as a result.

Treatment.—Thorough cleansing of the wound and freshening of its lips; sutures are then inserted and the part painted with a solution of iodoform in collodion. When the cartilage is divided pin-sutures are preferable. The horse should be put on the pillar-reins to prevent his rubbing the part and thus displacing the sutures.

Occasionally much difficulty in obtaining healing may be found when immediate treatment has not been applied.

Wounds of the Tongue.—These vary from a trivial injury to an extensive laceration of the organ.

Wounds of the tongue may be produced by a severe bit and a rough driver; also by rough handling of the organ when giving a ball or filing the teeth, and injury is more likely to occur if the horse rears up during the procedure. A serious wound is also caused by the reprehensible practice of passing a rope or cord around the tongue in attempting to control nervous or vicious horses. The tongue may also be wounded in its lateral aspect by sharp edges on the molar teeth.

Treatment.—Trivial wounds of the tongue heal rapidly; all that is required is an antiseptic and emollient mouth-wash, such as one composed of borax, honey, and water. Soft food should be ordered for the patient. In more extensive wounds suturing may be necessary, though often healing takes place without sutures. The best suture material for the purpose is silk, and the stitches should be inserted deeply and close together. Sloppy food should be ordered and a mouth-wash used at intervals.

When extensive bruising and laceration of the tongue are present, sloughing is liable to occur, and it is necessary to remove surgically the necrosed portion—amputating through sound tissue.

Wounds of the Hard Palate.—Sharp-pointed foreign bodies in the food may wound the hard palate, but such wounds usually heal rapidly. If, however, the palatine artery be wounded surgical attention is necessary, as serious hæmorrhage is likely to result. This accident has occasionally occurred when an amateur, in lancing the palate for the imaginary affection called "lampas," has made incisions towards the side of the palate instead of in the centre, and severed one of the palatine arteries.

Treatment.—The hæmorrhage is often very difficult to control, as owing to the constant movement of the tongue blood is prevented from clotting in the arterial opening. Pressure applied by means of a tampon of tow and a tape bandage fixed around the upper jaw beneath the lip is preferable to a bandage applied over the nose. In placid horses the actual cautery may be used, or a suture may be passed through the lips of the wound by means of a curved needle, and this checks the bleeding. In nervous or vicious horses it may be necessary to resort to casting before the bleeding can be stopped.

Wounds of the Soft Palate.—The commonest cause is injury inflicted by the attendant in attempting to administer a ball by means of a pointed stick. Considerable inflammation results from such a wound, which is likely to extend to the pharynx and to produce septic pharyngitis.

The symptoms observed are: difficulty in swallowing, quidding of food, flow of saliva from the mouth; in some cases the saliva is fœtid and streaked with blood. When the inflammation extends to the pharynx the head is "poked out" and there is considerable swelling in the external pharyngeal region, swallowing even of fluids may be impossible, fluid food, water, etc., being returned by the nostrils.

Treatment consists in the administration of an electuary composed of belladonna, chlorate of potash, borax, honey, and glycerine. This is placed as far back as possible on the tongue by means of a wooden spoon, three times daily. Should acute pharyngitis exist, a hot cataplasm of thermofuge should be applied to the throat. In severe cases the application of a blister is indicated. The food should be restricted to oatmeal gruels, linseed-tea, barley-water, milk, etc.

Wounds of the Cranial Region and of the Orbit.—These result from injuries such as occur when a horse running away comes into violent contact with a wall or a gate-post, and may also arise during the struggles of an animal suffering from "megrims." In some cases the skin carrying the forelock is torn in the form of a flap. A contused wound of the orbit may appear insignificant at the time of infliction, but owing to the bruising of the tissues and their infection an extensive swelling results and involves the eyelids and surrounding parts.

Wounds in this region must always be regarded as serious, and special precautions should be adopted to prevent or overcome infection. Septic cellulitis or erysipelas is not uncommon as a complication, which extends to the structures within the orbit, and the inflammation may spread to the coverings of the brain (meninges) owing to the fact that one of these coverings, viz. the dura mater, is continuous with the periosteum of the orbit through foramina by which the nerves and blood-vessels gain entry and exit.

For a wound in this region which shows contusion suturing should not be practised. Thorough cleansing with an antiseptic solution is essential, and all necrotic tissue should be removed with dressing-forceps and scissors. On the first appearance of cellulitis a dose of polyvalent anti-streptococcic serum ought to be administered. Similar remarks apply to wounds in any part of the cranial region. If, however, a long incised wound exist, suturing is desirable, care being taken to provide sufficient drainage and to remove the stitches on the first appearance of suppuration.

When a wound involves the skin carrying the forelock the hair should be closely removed, including the forelock itself, and the deep parts of the wound thoroughly irrigated with Dakin's solution until the part is as clean as possible. Suturing is then carried out, taking care to provide sufficient drainage. Daily attention is necessary in order to detect as early as possible the advent of suppuration and to remove a few of the sutures so as to permit of thorough irrigation and free drainage. As a rule this type of wound is difficult to heal.

Wounds of the Eyelid.—These are of common occurrence and usually result from contact with a nail or other sharp body in the stable. The eyelid may be torn so that it only remains attached by one extremity.

The edges should be freshened and the part thoroughly cleansed. Interrupted sutures of fine silkworm gut are then inserted, taking care to get the parts into perfect apposition. The wound is then dried with absorbent cotton-wool, and painted with iodoform collodion. The horse should be put on the pillar-reins for four or five days to prevent him rubbing the part and disturbing the sutures. As a rule primary union takes place provided sufficient care be bestowed on the disinfection of the wound.

Wounds of the Eye.—Wounds and injuries of the eye will only be mentioned here, and for further information regarding their nature and treatment the reader is referred to the article entitled "Diseases of the Eye and its Appendages."

Punctured wounds of the eye are of comparatively common occurrence in veterinary practice, and may result from contact with a sharp-pointed body, and, in hunters, from a thorn or sharp twig penetrating the cornea. The resulting injury varies according to the depth of the puncture and the amount of damage done to the interior of the eye, while the degree and virulence of the infection which may complicate the injury have an important influence on the gravity of the case.

A small puncture of the cornea may heal after the resulting inflammation of the cornea (keratitis) has subsided, but a common sequel is the formation of a cicatrix at the site of injury, which is at first of a bluish colour and later becomes white, forming what is known as a nebula.

In more extensive punctures of the cornea, associated with infection, the eye may become completely disorganized. A blow from a stick may cause extensive laceration of the cornea, with escape of the aqueous humour and luxation of the lens.

In the treatment of wounds of the eye it is advisable to employ a lotion having sedative and antiseptic properties, when acute inflammation is present. For this purpose the following may be applied twice daily: extract of belladonna, 1 ounce; boric acid, 4 drachms; cherry-laurel water, 4 ounces; and water to make 1 pint. Lint soaked in this lotion may be placed over the eye and secured by means of tape fixed to the head-collar.

For an incised wound of the cornea sutures of very fine silkworm gut may be employed to bring the edges together. In order to carry this out with facility a local anæsthetic such as a 10 per cent solution of cocaine combined with a solution of adrenalin should be applied to the eye.

In serious wounds of the eye accompanied by collapse of the globe, treatment should be directed to allaying inflammatory action and the prevention of infection. The remaining portion of the eye will shrink, and usually it gives no further trouble. It is only in rare instances that excision of the eyeball is necessary, and operative measures should be delayed until it is found that a suppurative condition is likely to persist. From an æsthetic point of view a shrunken eyeball is preferable to an empty socket.

Wounds of the External Ear.—These in the horse may be caused by nails or hooks and occasionally as the result of bites. In the dog, especially in the long-eared variety, wounds of the ear are of common occurrence, being usually due to bites sustained in fighting.

In the horse, if the wound is confined to the skin, it usually heals satisfactorily when the edges are sutured. When the cartilage is slit by the injury there is considerable difficulty in obtaining union. The edges should be freshened and the part thoroughly cleansed with an antiseptic solution; interrupted sutures are then inserted through both skin and cartilage on the internal and external surface. In some cases a portion of the cartilage may be torn off by the injury, and a permanent blemish then results.

In long-eared dogs the cartilage does not extend to the point of the ear, and in the latter region it is replaced by a fascia-like tissue. Wounds of the tip of the ear in such dogs are often very difficult to heal in consequence of the animal constantly shaking the head, and thus causing continuous irritation of the part. Not uncommonly the edges of the wound become thickened, and even ulceration may occur. In such cases it is necessary to prevent movement of the ears by applying a bandage round the head or a special cap to cover the head and ears.

Wounds of the Lower Jaw.—These are usually the result of a kick from another horse. Occasionally the submaxillary artery or vein may be severed and will require ligation. The salivary duct may also be wounded and a salivary fistula established.

In some cases a circumscribed fracture of the lower jaw may be produced, and in this event the wound should be enlarged and the loose pieces of bone removed.

Wounds of the Poll.—Wounds of the poll are usually caused by the animal striking its head against a sharp projecting body in the stable. The great danger in such cases is the formation of sinuses, and the production of the condition known as Poll-Evil (see article "Poll-Evil").

In the treatment of wounds of the poll it is essential to provide proper drainage and, as far as possible, to prevent infection of the bursa which lies between the funicular portion of the ligamentum nuchæ and the second cervical vertebra. If, owing to a punctured wound, infection of this bursa occurs, free incision is necessary and treatment similar to that prescribed for poll-evil is indicated. In treating wounds associated with contusions of this region, care should be taken to search for and remove loose portions of bone.

Wounds of the Neck.—Wounds in the region of the ligamentum nuchæ are apt to give considerable trouble, as pyogenic infection often extends to the ligament and induces necrosis.

Special attention to drainage is necessary in the treatment of such wounds, and frequently free incisions are required. Should any evidence of necrosis be present the part should be thoroughly curetted. As a result of a wound in the vicinity of the jugular furrow the jugular vein may be punctured or severed, or the carotid artery may be wounded. The latter is, of course, the more serious condition, as death from hæmorrhage may rapidly ensue unless the vessel be ligatured. When the jugular vein is wounded or severed, it should be ligatured not only at the upper end of the wound but also at the lower end, the reason for the latter precaution being to prevent the entrance of air into the vein.

In a wound with exposure of the jugular vein which is unwounded, it is advisable to ligature the vessel, as owing to it being subjected to stretching during the movements of the neck it may rupture and cause fatal hæmorrhage—an accident that occurred in our experience. When the carotid artery is wounded, immediate steps should be taken to apply a ligature to it. Even when the wound in the skin is small, ligation is necessary. The skin wound should be enlarged, and the vessel sought for with the fingers, and artery forceps temporarily applied above the bleeding-point if the wound is a punctured one. The vessel is then drawn forward and separated from the nerves which accompany it, and ligatured on each side of the puncture. Some authors advise that the vessel should now be divided between the two ligatures so as to avoid its giving way at the point of ligature, owing to the tension which is normally present. In cases where the artery is completely severed by the injury, the lower end should be sought for, secured by artery forceps, and a ligature applied. The upper end should also be ligated, but owing to retraction either end may not be within reach. The reason for ligating both ends when practicable is on account of the collateral circulation, and bleeding would follow from the upper (peripheral) end of the vessel if this precaution were not taken.

The injury may cause division of the vagus and recurrent nerves, and thus produce roaring.

A wound caused by the shaft of a car may perforate the *trachea*, and mechanical pneumonia may result owing to blood gaining entrance to the lungs. The symptoms pointing to perforation of the trachea are: blood-stained discharge from the nostrils, an emphysematous condition of the skin in the region of the wound (the presence of air under the skin), and frothy discharge from the wound. Fits of coughing, marked difficulty in breathing, and a blood-stained nasal discharge are suggestive of the entrance of blood into the lungs.

The treatment of wounds involving the trachea is to be conducted on ordinary surgical principles. Bleeding vessels should be ligatured, and in cases where extensive swelling of the neck occurs, causing compression of the trachea and interfering with respiration, a tracheotomy tube must be inserted below the seat of the injury. If, however, the wound is situated very low down, the tracheotomy tube must be secured in the tracheal opening so that it cannot get displaced.

The *œsophagus* may be penetrated by a punctured wound inflicted by the horn of a cow, in the vicinity of the jugular furrow of the neck. As a rule the injury producing it is situated in the lower third of the region. The characteristic symptom of the lesion is the presence of masticated food and saliva in the wound. With regard to treatment, the wound in the gullet should be sutured, after careful cleansing has been carried out. If the skin wound is extensive, the edges should be brought together by sutures, taking care to provide proper drainage. The animal should be fed on fluid foods until the wound in the gullet heals.

Wounds of the lower region of the neck, close to the scapula, are not uncommon as the result of penetration by a shaft of a car during a collision. In such cases the wound may extend deeply between the scapula and the thorax and prove very serious, as efficient drainage is difficult to obtain, and there is much laceration of muscular tissue. In some cases the injury produces fracture of a rib—a very grave condition.

In the treatment of such wounds the first consideration is the suppression of hæmorrhage, should a blood-vessel be severed. In consequence of the position and depth of the wound great difficulty is experienced in securing the vessel, and it may be necessary to enlarge the orifice before ligation can be carried out. Plugging the wound with carbolized tow soaked in compound tincture of benzoin will succeed in the case of hæmorrhage from small vessels, but will fail if a large artery is involved. The next step in treatment is to provide proper drainage for the wound. A wound extending behind the scapula presents the greatest difficulty in the way of efficient drainage, and owing to the constant movement of the shoulder-blade healing is interfered with. It must not be forgotten that in the attempts to provide drainage a large blood-vessel may be cut, and may be very difficult to ligate owing to its situation. Another point of importance is that prognosis in wounds of this kind should be guarded, as it is impossible in the early stages to ascertain the amount and extent of the injury inflicted on deep-seated structures.

No hard and fast rule can be laid down with regard to the technique of providing drainage; each case will require special measures depending on the direction of the wound.

Having made every effort to secure a dependent opening, the wound should be thoroughly irrigated with an antiseptic solution by means of a continuous-flow pump and rubber-tubing. This is to be carried out daily, but in the case of a wound which is deeply infected the procedure ought to be repeated three times daily. If a hosepipe attached to a water-main be convenient, the preliminary daily cleansing should be carried out by this means, and the irrigation completed with an antiseptic solution. For efficiency and cheapness Dakin's solution can be recommended. In spite of all precautions sinus formation may occur as a sequel and prove very obstinate to treatment. Should free incision and curetting of the sinus fail to bring about healing, a strong solution of sulphate of zinc (4 ounces to 1 pint of water) may be injected daily, and frequently it succeeds in effecting closure. As an auxiliary to surgical treatment an autogenous vaccine (*i.e.* one prepared from the pus that issues from the sinus) should be employed.

In the treatment of shaft wounds of the breast the principles are similar to those mentioned under "Wounds of the Lower Region of the Neck." By the exercise of a little ingenuity it is possible in some cases to provide a dependent opening for drainage. Irrigation with an antiseptic solution, repeated at frequent intervals, is of great importance. A careful watch for the early evidences of sinus formation is very desirable. Constant discharge of pus and the presence of a smooth-walled channel associated with lack of healing should indicate the need for a free incision so as to enlarge the opening at the surface and to curette the interior of the wound. Sinuses in this region may persist for an indefinite period in spite of treatment. In adopting surgical measures to bring about healing it is necessary to be very thorough in the technique, and to endeavour if possible to reach the depth of the sinus, then provide drainage, seek for the presence of a foreign body or a portion of necrotic tissue, remove it, and then use the curette freely.

Sinuses in the vicinity of the sternum are amongst the most troublesome conditions encountered by the veterinary surgeon. Here, too, the knife should be freely used, but the risks of hæmorrhage from deep-seated vessels being severed must be remembered. In some instances a portion of the sternum may have become necrotic and must be removed by a strong curette.

In carrying out operative measures for the above conditions the horse should be cast and chloroformed, as it is impossible to control hæmorrhage with the animal in the standing position.

In cases which resist the treatment mentioned, we have seen good results follow the daily injection into the sinus of a strong solution of sulphate of zinc (1 part of zinc sulphate to 5 parts of water).

Instances occur in which a sinus between the shoulder and the thorax heals at its anterior extremity and a new opening forms in the vicinity behind the elbow.

Open Shoulder-joint.—This condition is not of common occurrence, owing to the fact that the joint is fairly well protected from injury.

The treatment of open shoulder-joint is to be conducted on similar lines to those already advised. The injury must be regarded as a very serious one, and if suppurative arthritis occurs permanent lameness is likely to result.

Wounds of the Axillary Region.—The axillary region is situated between the inner and upper aspect of the elbow and the sternum. It contains much loose cellular tissue. A frequent complication of a punctured wound in this region is *surgical emphysema.* This is a condition in which air gains access *via* the wound to the cellular tissue and spreads rapidly to the shoulder, neck, and even to the head. The affected parts appear distended, and on manipulation they feel like an air-cushion. When, as sometimes occurs in hunters that are wounded in the axillary region, the animals are walked some distance home, the emphysematous process may extend even to the hindquarters.

Another point in connection with such wounds is that, in consequence of their situation, healing is difficult to promote owing to the movement of the limb.

Surgical emphysema requires no special treatment, as the air disappears gradually after a few days.

A punctured wound in the region mentioned should, after being thoroughly cleansed and disinfected, be plugged with a tampon of gauze soaked in an antiseptic solution. This treatment should be carried out daily. The animal should be left in the stable so as to give the part as much rest as possible.

Wounds of the Forearm.—Punctured or lacerated wounds of the upper region of the forearm either on the inside or outside of the limb must always be regarded as serious, in consequence of the tendency for infection to extend under the fascia and reach the elbow-joint.

The synovial membrane at the posterior aspect of the elbow-joint lines the tendons or origin of the flexor muscles of the limb. This explains the facility with which infection of the tendon sheaths in the case of septic wounds in this region spreads to the elbow-joint, causing suppurative arthritis.

In the treatment of wounds of the forearm it is of the greatest importance to provide efficient drainage early and to carry out thorough disinfection. Even in the case of a small punctured wound such as that caused by a prod with a stable-fork, a free longitudinal incision should be made so as to enable the part to be efficiently disinfected and prevent the spread of infection under the fascia or along the tendon sheaths.

We may point out that in the treatment of wounds of the forearm, with the exception of those only involving the skin and subcutaneous tissue, sutures should not be employed.

Open Elbow-joint.—This condition may arise from a kick or a puncture from a stable-fork. Suppurative arthritis usually results, accompanied by very acute pain and lameness and extensive swelling of the joint. The other phenomena are similar to those mentioned under the heading of "Open Joint." Although early treatment be adopted, it is seldom that the part can be rendered aseptic. The usual experience with regard to suppurative arthritis of the elbow-joint is that treatment of any kind is useless, as even if the suppurative condition be overcome, a stiff joint with permanent lameness results.

As already mentioned, suppurative arthritis of the elbow may occur as the result of a septic wound of the forearm.

A wound at the posterior part of the elbow may, by sloughing, extend to the joint, as at this point there is no ligament, and the muscles directly support the synovial membrane.

Wounds of the Knee.—These are of very frequent occurrence in the horse. The term "Broken Knee" is applied to abrasions or wounds of the front of the knee, resulting from a fall on a hard surface or on a sharp stone.

Wounds of the knee at any part of the joint are common in hunters, and may be inflicted by sharp stones or a sharp-pointed branch of gorse. Barb wire and a prod from a stable-fork are not infrequently causes of wounds of the knee, also a kick from another horse may inflict a very severe injury in this region.

Dealing first with "broken knee" we may remark that the term includes injuries which vary much in extent and gravity.

In the least serious type the skin in front of the knee is abraded but not cut through, and a slight oozing of blood occurs. The treatment of such a case is simple. All mud, dirt, etc., should be carefully removed by irrigation with an antiseptic solution, and a dry dressing, composed of equal parts of boric acid and oxide of zinc, dusted over the wound. The horse should be prevented from lying down until the part is healed, as unless this precaution be taken, the pressure to which the knee is subjected while the animal is in the recumbent position is likely to cause further injury to the skin and to damage the hair roots, and so lead to a permanent blemish. Should the knee swell to any extent, the application of cold water is indicated.

A more serious form of broken knee is that in which the skin is cut through. As a rule the part is bruised to a greater or less extent and the subcutaneous tissue is exposed.

Mud, gravel, etc., gain entrance to the wound, and in carrying out treatment the first essential is to remove all foreign bodies by irrigation and the use of dressing-forceps. The initial cleansing of the wound is of supreme importance, and should be carried out very thoroughly. If, as not uncommonly happens, a pouch or pocket of skin is formed at the lower aspect of the wound, the judicious use of the knife is necessary in order to provide drainage and prevent an accumulation of discharge from the wound.

Having thoroughly cleansed the part by irrigation with an antiseptic solution, the knee should be enclosed in a layer of double cyanide gauze soaked in Dakin's solution, and a thick layer of cotton-wool applied over this and kept in place by a bandage. The periods at which the dressings should be changed will depend on the amount of discharge, and when the latter soaks through the wool and bandage the wound should be re-dressed.

In the case of a more severe injury the tendons passing over the front of the knee are exposed and much damage is done to the skin and underlying tissues. The bursa of the large extensor tendon is opened, and synovia appears in the discharge from the wound. Considerable pain, swelling, and lameness are present, and the case may be mistaken for one of open joint.

The swelling extends both above and below the knee, the limb is kept in a semi-flexed position, and movement is performed with difficulty.

The treatment in such cases is to provide proper drainage, to remove foreign bodies and all shreds of injured fascia, and to irrigate the wound thoroughly with an antiseptic solution. The knee should then be enveloped with gauze and cotton-wool, as already described, and the animal placed in slings. Irrigation with Dakin's solution should be carried out daily. If the discharge of synovia from the open bursa be profuse, it is advisable to inject for a few days the following: Lugol's solution of iodine 1 part, glycerine 4 parts.

In some cases, where the injury to the tendon has been excessive, sloughing of this structure may occur, and even rupture. Such lesions are usually hopeless. Permanent enlargement of the knee, and stiffness of the joint due to adhesion of the tendon to the surrounding parts, are not uncommon results in broken knee complicated by open bursa. In order to prevent this undesirable sequel it is advisable not to keep the animal in slings for too long a period, and prescribe gentle walking exercise as soon as possible. If, after the part has healed, it is found that flexion of the knee-joint is interfered with, the animal should be cast and chloroformed and the knee forcibly flexed so as to break down the adhesions.

Open Knee-joint.—This may occur from falls during which the knee comes into contact with a sharp stone. It is also met with as the result of a puncture received in the hunting-field, or from a prod with a stable-fork. Of the joints comprising the knee the most serious when opened is that between the lower end of the radius and the upper row of knee-bones (the radio-carpal joint), an open joint between the two rows of knee-bones (the intercarpal) is less serious, while the least serious is the joint between the lower row of knee-bones and the head of the metacarpus (the carpo-metacarpal joint).

It may be taken as a general rule that an extensive opening into the first two joints mentioned, except in the case of a valuable stallion or brood mare, seldom repays the cost of treatment, as a stiff and greatly enlarged knee is the usual result, and not uncommonly the animal succumbs to some complication or eventually has to be destroyed. Simple punctures without severe injury of the surrounding tissues are more hopeful.

The treatment to be adopted has already been mentioned under " Open Joint."

Punctured wounds at the back of the knee are met with in hunters, and prove very tedious in consequence of the constant movement of the joint interfering with healing.

Punctured and lacerated wounds of the knee resulting from injuries sustained in the hunting-field, or from kicks, are to be treated according to ordinary surgical principles. It is of the greatest importance to provide proper drainage, and to make a thorough search for foreign bodies.

Wounds from thorns are common in hunters, and, owing to the small size of the external opening, they are apt to be overlooked. Considerable swelling and tenderness of the knee may result, accompanied by lameness. The thorn which has caused the injury may be embedded completely in the tissues, or the point only may be present, the remainder having been broken off either at the time of the accident, or subsequently by the owner or attendant in their efforts to remove the foreign body.

In the treatment of this injury, if any portion of the thorn can be located by manipulation, the small opening in the skin should be cautiously enlarged and the foreign body removed by means of forceps; the wound is then to be treated in the ordinary manner. If, however, the thorn cannot be located, a thick hot layer of thermofuge should be applied to the knee and repeated daily. This may succeed in causing the thorn to approach the surface so that it can be removed. If this measure fails, the case must be left to nature, as it would not be rational treatment to explore for a foreign body without being certain of its location. At times a thorn comes to the surface of the skin long after its penetration, and makes its exit through a small abscess.

Wounds of the Metacarpal Region.—The most important of these are wounds involving the tendons and tendon sheaths in this region. Such wounds may occur from contact with sharp bodies, barb-wire, etc., and are not uncommon in hunters as the result of injuries inflicted by sharp-pointed stones in a wall. Wounds of the flexor tendons vary in extent and gravity. In very severe injuries either one or both flexor tendons may be severed. When the perforatus tendon alone is divided lameness may be trivial and the toe of the foot may be turned upwards to a very slight extent.

Division of the perforans tendon results in a well-marked turning up of the toe at every attempt of the animal to stand on the limb.

Wounds involving the sheath of the flexor tendons must always be regarded as very serious, as the suppurative inflammation of the tendon sheath is apt to result, and may terminate in disease of the tendon itself. An open tendon sheath is evidenced by severe lameness, acute pain, extensive swelling along the course of the tendon, and the presence of a synovial discharge from the wound.

The treatment of wounds of the tendons is to be conducted according to ordinary surgical principles. In the case of suppurative inflammation of the tendon sheath which extends in an upward and downward direction it is advisable to enlarge the opening in the sheath by an incision so as to provide drainage and prevent extension of the infection to the fetlock. Thorough irrigation with Dakin's solution should then be carried out, and the part enveloped in gauze soaked in a similar solution, and covered with a thick layer of cotton-wool. Exuberant granulations must be checked by the judicious application of finely-powdered sulphate of copper. When the synovial discharge is persistent it is advisable to inject the following every third day: Lugol's solution of iodine, 1 part; glycerine, 4 parts.

In the case of a tendon being divided, suturing should be attempted, although the chances of union taking place are rather uncertain. The best form of suture for the purpose is a variety of mattress suture (known as Le Furt's) which is passed through the entire thickness of each end of the tendon and may be reinforced by additional sutures. The horse should be placed in slings and a high-heeled shoe applied.

Similar remarks apply to division of the extensor tendons, but in this case the high-heeled shoe is not required.

Contusions of the Inner Aspect of the Metacarpal Region.—This is a common injury resulting from the inner edge of the shoe of the opposite foot, and is known as "Speedy Cut."

The contusion may be situated just above the knee, or at the inner side of the joint, or further down the metacarpal region. In some cases the skin is broken, in others a swelling is produced which may contain serum or even blood. When the lesion has been in existence for some time and the animal continues to "strike" the part, an abscess may form with sloughing of the skin. Not infrequently a chronic enlargement of the part is produced. As regards treatment, in mild cases hot fomentations, or the application of a cataplasm of thermofuge for a few days, reduces the swelling. In cases where a soft enlargement containing much serum is present, it is advisable to make a free incision and to remove the contents, the cavity is then packed with gauze soaked in solution of hydrogen peroxide, and the dressing changed daily. When pus formation takes place as the result of speedy cut, a free incision should be made and the cavity irrigated with an antiseptic solution. Attention to shoeing is necessary so as to prevent a recurrence of the injury. The shoe of the opposite foot should have a feather-edge on the inside and be nailed on the outside only.

Wounds of the Fetlock.—These are of very frequent occurrence in hunters, the common location being on the anterior aspect of the fetlock. The usual cause is contact with a sharp stone while jumping a bank. The type of wound varies. In some instances it is in the form of a puncture which penetrates the tendon of the extensor pedis, and enters the synovial bursa which is interposed between the tendon and the anterior surface of the joint. In others, the wound is lacerated and contused, and the bursa may or may not be opened. Again, injuries occur in which the fetlock-joint is opened, in which instance the extensor pedis tendon and the anterior ligament of the joint must be punctured before the synovial membrane of the articulation is reached. In the case of a puncture involving the bursa of the tendon the lameness may be slight at first, and the external opening small in extent. Within twenty-four hours or so, very acute lameness and pain are manifested, and a discharge of synovia is observed from the wound.

In the treatment of this injury experience has taught that in order to cleanse the wound thoroughly and to provide drainage it is necessary to enlarge the opening. Not infrequently a foreign body such as a small piece of stone may be present which, if not removed, will cause continuous suppuration and ultimately sinus formation. This bursa may also be punctured by a thorn, and not uncommonly a portion of the latter may become embedded in the part and give rise to chronic lameness.

In cases where acute pain and lameness are present, after enlarging the opening of the wound it is good practice to apply a cataplasm of thermofuge for a few days; this relieves pain and, in the event of a foreign body being present, has the effect of bringing it towards the surface, so that it can be removed. The treatment of more extensive wounds of the anterior aspect of the fetlock is conducted on similar lines to those just mentioned. Not infrequently wounds in this region appear to heal, but later swelling and suppuration occur. In such instances it is necessary to make a free incision and curette the interior of the wound. In cases where there is a persistent discharge of synovia a few injections composed of Lugol's solution of iodine, 1 part to 4 parts of glycerine, should be carried out. As a sequel to open fetlock bursa a chronic enlargement of the front of the fetlock is usual. This can be reduced to some extent by the application of a biniodide of mercury blister.

Wounds of the posterior aspect of the fetlock are also met with, and occur as the result of contact with a sharp stone. In some instances the sesamoid sheath may be punctured and serious consequences are likely to result.

Open Fetlock-joint.—As already pointed out, this joint on its anterior surface is well protected, but nevertheless a sharp-pointed body may puncture to the synovial membrane. It is easy to mistake an open bursa for an open fetlock-joint, and attempts to differentiate the two conditions by exploring with a probe must be condemned, as they are likely to introduce infection into the joint should the latter be opened. In open fetlock-joint the constitutional disturbance is greater, the pain more acute, the lameness more intense, and the discharge of synovia more profuse than in open bursa.

The treatment of open fetlock-joint is to be conducted on similar lines to those advised under "Open Joint."

Similar remarks apply to open pastern-joint.

Brushing is the term applied to contusion, abrasion, or wound caused on the inside of the fetlock owing to the part being struck by the shoe of the opposite foot. The lesion is to be treated on ordinary surgical principles. Prevention consists in ascertaining which part of the shoe causes the injury, and taking steps to round off the shoe at this point. In obstinate cases a "preventing" boot should be worn.

Wounds of the Coronet.—The most common injury to this region is an open contused wound produced by the horse treading with the heel of one foot on the coronet of the opposite one. Cases of the kind are most frequently observed during frosty weather when a horse is "sharpened" so as to enable him to travel on slippery roads. The wound produced may involve either the coronary band, the skin and subcutaneous structures, the tendon of the extensor pedis, the lateral cartilage, and sometimes even the synovial membrane of the coffin-joint. Treads occurring in severe frosty weather (which is the most likely time for them to be met with) are to be regarded as serious, and are especially dangerous when horses have to work after snow has fallen, as the wound is subjected to the devitalizing influence of severe cold, and may become infected by slush. Not infrequently the result is extensive sloughing of the tissues, and in some instances the necrosing process may extend to the coffin-joint and prove fatal. When the injury is situated in front of the coronet over the pyramidal process of the os pedis, the tendon of the extensor pedis may be punctured, and the coffin-joint opened at this point. Injury to one of the lateral cartilages may terminate in "quittor." The necrotic process may extend to the sensitive laminæ of the foot, and lead to separation of the horny and sensitive laminæ. Destruction of a portion of the coronary band may result in the formation of "false quarter."

Serious injuries to the coronet may result from the wheel of a heavy float passing over this region. Some bruising of the tissues is produced, and this leads to extensive sloughing; not uncommonly a portion of the os pedis may be broken off, and occasionally a fracture of the navicular bone also results. Wounds of the coronet caused by a sharp body may sever one of the branches of the digital artery and give rise to considerable hæmorrhage.

Treatment.—In all traumatic injuries to the coronet thorough cleansing and disinfection of the wound is of great importance. A careful search should be made for foreign bodies, and if present they must be removed. Any loose shreds of tissue should be excised by means of scissors. The entire foot is then thoroughly cleansed and washed with a strong antiseptic solution, and immersed to above the coronet in a bath of Dakin's solution for half an hour. A dressing of gauze soaked in the same solution is next applied, followed by a layer of cotton-wool, which is kept in place by means of a properly adjusted bandage. Daily dressing should be carried out. In cases accompanied by acute pain it is advisable to apply a cataplasm of thermofuge for a few days until inflammatory symptoms are reduced. If a portion of the horn of the wall close to the coronary band is detached it should be removed by a sharp dressing-knife. In cases where injury to the os pedis is suspected it is advisable to place the patient in slings, and to apply the cataplasm already mentioned over the foot and coronet. In the event of a small portion of the bone being chipped off it will find its way to the surface, and can be detected and removed after enlarging the wound by the employment of a sequestrum forceps. Injuries such as fracture of the os pedis extending to the articulation, or of the navicular bone or open coffin-joint, are hopeless.

In wounds of the coronet associated with division of one of the branches of the digital artery it is necessary to secure and ligate the severed vessel. Not infrequently this is difficult to carry out as the vessel retracts within the tissues. The application of a tourniquet above the fetlock assists procedure. In an emergency case, where artery forceps are not at hand, pressure by means of a pad of tow secured by a bandage will succeed in arresting the bleeding. In deep wounds of the coronet in the vicinity of the lateral cartilage, sinus formation is not uncommon. Care should be taken to examine the part so as to detect the early signs of this lesion, and adopt suitable treatment, which will consist in the free use of the curette and the provision of proper drainage. When, in spite of this, disease of the lateral cartilage sets in, surgical measures must be adopted (see article on "Quittor").

Wounds of the Heel.—These may result from hunting cuts or a prod from a stable-fork. A cracked heel, if neglected, may develop into a deep fissure, which, owing to the tension on the part, is very resistant to treatment. An "overreach" is of common occurrence in hunters, and consists of an irregular wound in the vicinity of the heel caused by the toe of the corresponding hind shoe; in some cases the coronary band at the heel is involved in the injury.

In the case of a punctured wound of the heel the sheath of the tendon may be involved, or the tendon itself may be implicated. The symptoms presented are: acute lameness, severe pain, swelling of the heel which tends to extend to the fetlock, and a discharge of synovia. The appropriate treatment is similar to that advised for wounds of tendons.

A fissured heel is best treated by applying a cataplasm of thermofuge for a few days, then the part should be thoroughly cleansed and the crack packed with dry dressing composed of iodoform ½ an ounce, oxide of zinc 1 ounce, and boric acid 1 ounce, and covered with a layer of cotton-wool and a bandage. In some cases healing is hastened by the judicious application of nitrate of silver to the edges of the fissure.

Perfect rest should be ordered. A shoe slightly raised at the heels favours approximation of the edges of the crack.

In the treatment of "over-reach" the wound should first be thoroughly cleansed and disinfected. When a flap of skin and tissue including the junction between it and the horny frog is almost completely detached, immediate excision is advisable, as there is no possibility of union taking place and an unsightly blemish will result if the part is left to itself. In cases of less extensive injury the ragged edges of the wound should be trimmed and an endeavour made to promote union by applying antiseptic dressings and a layer of cotton-wool. Exuberant granulations must be checked by the application of powdered sulphate of copper. Wounds at the junction of the skin and coronary band are sometimes followed by a horny growth, which must be repressed or removed by a hoof-knife.

Wounds of the Foot.—These comprise the following: (1) Injuries caused by "picked-up nails." (2) Injuries caused by the animal treading on sharp bodies such as pieces of iron or glass, and penetrating wounds of the frog arising from a sharp-pointed stone or branch of gorse. (3) Pricks or stabs in shoeing.

Injuries caused by "Picked-up Nails."—These are of very common occurrence in city practice in consequence of the careless manner in which packing-box nails are thrown on the street. Occasionally a puncture of the foot results from a shoe becoming loose and the horse treading on the toe-clip, or the animal may "pick-up" a shoeing nail on the floor of the forge. The gravity of a case of "picked-up nail" depends on the situation and depth of the puncture and on the nature and amount of infection introduced by the nail. The commonest seats of wounds caused by nails are: the point of the frog, the side of the frog at the junction of the latter with the sole, and the centre of the frog. Any part of the sole may, however, be punctured. The most dangerous location for the puncture is the centre of the frog, as the point of the nail may penetrate the perforans tendon and open the bursa or even injure the navicular bone. A puncture in the vicinity of the point of the frog may extend to the coffin-bone and cause necrosis. Not infrequently there is considerable difficulty in detecting the puncture caused by a nail, and unless a very careful examination be made of the sole and frog it will be overlooked in the diagnosis of a case of lameness.

Nail punctures of the foot may be superficial and simply wound the sensitive sole or sensitive frog, in which instances recovery takes place after simple treatment has been adopted. The shoe is removed and the horn should be carefully thinned in the vicinity of the puncture so as to bring the latter into view. With a French hoof-knife a circular portion of horn is removed around the puncture so as to afford drainage, a strong antiseptic is then applied to the wound, followed by a cataplasm of thermofuge kept in place by a layer of carbolized tow and a boot made of canvas. When pain and lameness increase, the foot should be well soaked in hot antiseptic solution twice daily. When lameness and discharge diminish, dry dressing with a leather sole is applied.

In cases where a deep puncture exists, free removal of the horn is essential, otherwise infection will extend, and ultimately find its way to the coronet. Poulticing with linseed meal must be condemned, although it is a popular method of treatment of wounds of the feet. It causes softening of the tissues, promotes infection, and increases pus formation. For the relief of pain and inflammation a cataplasm of thermofuge is preferable, and this can be alternated with the prolonged use of an antiseptic foot-bath. Excessive granulations, which are so common in wounds of the foot, may be removed by the knife or curette. Here we may remark that it is always advisable to remove the shoe from the opposite foot at the first examination of the case. If this precaution be neglected laminitis may develop in the foot, as owing to the inability to bear weight on the injured limb it is borne by the sound limb.

Tetanus being a not uncommon complication of wounds of the foot, the administration of anti-tetanic serum as a preventive is a wise course to adopt.

In cases where the os pedis has been punctured it is advisable to cast the horse, and to remove the sole around the seat of the puncture. The condition of the part can then be observed, and if necrosis of the sensitive sole exist, the diseased tissue must be removed by means of a curette. Necrotic changes in the os pedis at the site of the puncture should be sought for, and if present, should be curetted. In some instances a sequestrum forms and either exfoliates or has to be removed. These cases are always very serious, and in those that recover the course is slow.

When the nail punctures the tendon of the flexor pedis perforans the chances of recovery are very remote, and except in the case of a valuable horse the outlay in treatment is seldom justified. The extent of the injury varies from a septic inflammation of the bursa situated between the tendon and the inferior aspect of the navicular bone, to a puncture of the bone itself, followed by necrotic changes. Septic bursitis may lead to extensive disease of the tendon, and ultimately the suppurative process may extend upwards to the hollow of the heel and there find an outlet.

The only treatment likely to prove of any benefit in such cases is to expose the tendon, resect it, and remove all diseased tissues, including the terminal necrotic portion of the tendon. The horse is cast and chloroformed and the horny and sensitive frog removed over the site of the affected tendon. This is accomplished by making a triangular incision, the base of which corresponds to the base of the frog. The diseased portion of tendon will be recognized by its greenish or yellowish colour. It is removed after locating the navicular bone by making a transverse incision over the middle of this bone, followed by two lateral curved incisions. Care should be taken to avoid opening the coffin-joint. If any roughened surface is detected on the navicular bone it should be scraped by a curette. The entire operation must be conducted under strictly aseptic conditions. The part is then plugged with iodoform gauze and a layer of carbolized tow applied and kept in place by a properly constructed canvas boot. Needless to remark, this operation is one which can only be carried out in a properly equipped infirmary, and for economic reasons it has limitations, as we have already pointed out.

(2) *Injuries caused by Treading on Sharp Bodies such as Glass, etc.*—Broken glass may become embedded in the sole, especially in wet weather when the horn is soft and more easily punctured. The neck of a bottle when trodden on is capable of causing very extensive laceration of the frog, extending to the deep structures, and is often accompanied by severe hæmorrhage. In hunters it is not uncommon to find a small sharp bit of flint embedded in the sole or frog and causing severe lameness. A sharp-pointed piece of gorse may penetrate the cleft of the frog and prove very serious.

In many cases the presence of a foreign body in the foot may easily be overlooked unless a very careful examination be made, and the lameness may be erroneously ascribed to other causes. The error is discovered when a discharge of pus issues from the heel or coronet. Here we may point out that the pus in such cases is thin and of a greyish or blackish colour ; it is of a similar character when the injury results from a " picked-up nail."

Treatment.—In the treatment of the above injuries, the important point is to ensure that the foreign body is removed and efficient drainage provided. The after-treatment is similar to that advised for "picked-up nail" : a prophylactic dose of antitetanic serum is always advisable.

(3) *Pricks or Stabs in Shoeing—"Nail-bound," "Drawn Nail."*—These are injuries associated with shoeing, in some instances being accidents and in others due to carelessness.

The point of the shoeing nail may enter the sensitive membrane when carelessly driven, or when the nail-holes in the shoe are punched too close to the inner border of the web, or inclined too much in an upward and inward direction. The terms " drawn nail " or " blind stab " is applied when the farrier, finding he has either driven the nail too close to the sensitive membrane or wounded it, withdraws the nail and does not report the injury.

The term " nail-bound " signifies pressure exerted on the sensitive structures by one or more nails without actual penetration.

Treatment.—This will depend on the nature of the case. When pressure without actual penetration is present, removal of the shoe, soaking the foot in a tub of hot water, and the application of a linseed meal poultice will generally succeed in causing the lameness to disappear provided early treatment be adopted. In a neglected case suppuration occurs, and free drainage must be provided by removing a sufficient amount of the sole around the nail-hole. The foot is then soaked in hot antiseptic solution and a cataplasm of thermofuge applied. In cases of actual penetration of the sensitive membrane the nail-holes must be thoroughly opened up and similar after-treatment to that just mentioned should be carried out. When pus forms within the hoof, a free opening must be made in the sole, otherwise an abscess at the coronet, followed by quittor, may be the result. In the case of a " blind stab " a very careful examination of the foot is often necessary in order to detect the injury. For obvious reasons the smith who shod the animal should not be entrusted with the examination of the foot, unless under the personal supervision of the practitioner.

Wounds and Contusions of the Withers.—A bad-fitting saddle is a common cause of bruise or contusion in the vicinity of the withers. If the case does not receive attention and the cause is prolonged, a lesion of the skin is produced, and eventually a sinus of the withers may develop.

In the early stages swelling and tenderness of the withers are observed, and if the infiltration be slight and only affecting the skin, simple treatment will succeed in causing absorption of the serum in a few days. When, however, the extravasation of blood or lymph is subcutaneous the case becomes more tedious, while subfascial extravasation must always be regarded as serious. Suppuration may occur as a complication and extend to the deep tissues, and unless early treatment be adopted the case may terminate in fistulous withers.

According to some authors the fluctuating swelling which not uncommonly results from a bruise of the withers is due to inflammatory action in the bursa mucosa which lies on the superior spinous processes of the fifth to the seventh dorsal vertebræ.

This swelling is found close to the middle line and may appear on one or on both sides of the withers. The contents consist at first of blood-stained serum, but later it alters to an amber-coloured viscid fluid which contains a number of flat or discoid masses. As compared with the swelling due to extravasation of serum or blood, that resulting from bursitis is slower in development and better defined.

Treatment.—In slight contusions of the withers associated with tenderness, swelling, and infiltration rest must be ordered, and the application of a compress of lint soaked in a lotion composed of equal parts of Goulard's extract and water.

In more severe cases a thick cataplasm of thermofuge should be applied and covered by a layer of cotton-wool.

If the case be one of bursitis in the early stages similar treatment is indicated, and when the inflammation is reduced strong tincture of iodine should be applied daily. When this treatment fails a free incision should be made into the swelling, the contents evacuated, drainage provided, the part thoroughly irrigated with an antiseptic solution, and packed with gauze soaked in a liniment composed of creosote 2 drachms, oil of turpentine 4 ounces, and olive oil 1 pint. This dressing should be changed after twenty-four hours. Treatment by aspiration of the swellings is useless, as the part rapidly refills.

When, as the result of continued pressure from the saddle, an abrasion of the skin or an actual wound results, great care is essential in order to prevent deep-seated infection from occurring. If acute pain is present a cataplasm of thermofuge should be applied for a few days, succeeded by a dry dressing composed of iodoform ½ ounce, boric acid 1 ounce, and zinc oxide 1 ounce. In the case of a wound the part must be explored with a probe, and if the wound extends in a downward direction within the tissues, a free incision should be made so as to provide drainage and prevent sinus formation. Neglected cases may terminate in fistulous withers. For information on the latter condition the reader is referred to the special article on "Fistulous Withers."

Saddle-Galls.—These consist of bruises and sometimes excoriations of the skin or subjacent tissues arising from uneven pressure of the saddle, or pressure on parts unfitted to bear it. The common seats of saddle-galls are: the withers, the middle line of the back, or on either side of the vertebral column, *i.e.* the surface on which the saddle rests. Similar lesions in the last-named region may be produced by the harness straddle. The nature of the swelling produced is similar to that described as occurring in bruises of the withers. The presence of a "warble," originating from the grub of a variety of warble-fly, not infrequently is the starting-point of a saddle-gall, so also is an acne pustule, when subjected to pressure by the saddle.

The treatment of saddle-galls is to be conducted on similar lines to those advised for bruises of the withers. In the case of those arising from "warbles" the part must be fomented for a few days and the "grub" then squeezed out.

A not uncommon complication of saddle-gall is the formation of what is known as a "sit-fast," which is a circumscribed necrosis of the skin surrounded by a circular raw surface which suppurates. The affected skin assumes a tough leathery character, and is very firmly adherent to the subcutaneous tissue.

The only treatment likely to prove successful is to remove the necrosing portions of skin by careful dissection and to leave an open wound which heals by granulation. Unless this radical treatment be adopted, the lesion will persist and give constant trouble.

Collar-Galls.—Are similar in their nature to saddle-galls. They result from a badly-fitting collar, and should be treated on the same lines as those indicated for saddle-galls and bruises of the withers.

Wounds of the Chest-wall.—(1) Wounds of the chest-wall without perforation.

(2) Wounds which perforate the pleura and thoracic wall.

In both these classes of wound the usual causes are: injuries from a shaft occurring during a collision, kicks, punctures, or lacerations arising from a splinter of wood or a sharp-pointed stake or from barb-wire, and injuries from horned cattle. The wound may be situated on the side of the chest or may be sustained between the shoulder and the wall of the thorax, or it may penetrate through the caput muscles and enter the cavity of the chest.

For non-penetrating wounds of the thorax treatment must be conducted on ordinary surgical principles, the most important being the provision of efficient drainage and thorough irrigation with an antiseptic solution. The necessity for sutures will depend on the nature and extent of the wound. For an extensive lacerated wound the judicious employment of sutures, provided sufficient drainage be secured, will hasten healing and lessen resulting blemish. In many instances it is difficult to decide at the first examination of the case whether the thorax has been penetrated or not. Commonsense will suggest the necessity to avoid the use of the probe in deciding the question, because of the risk of making an opening into the pleural cavity.

When dealing with penetrating wounds of the breast we pointed out the difficulties associated with cases in which the wound extended between the shoulder and the chest-wall. Apart from the immediate dangers such as fatal hæmorrhage owing to injured blood-vessels, and from penetration of the thoracic cavity, the impossibility of securing proper drainage must be considered. Another serious complication which is often associated with wounds of the thorax is injury to one of the ribs which may terminate in a *costal fistula*. Not infrequently this lesion proves most obstinate to treatment. The direction of the fistula must be ascertained by means of a probe, the part is then freely opened up, and the sequestrum, if present, removed. Thorough curetting is then carried out, and the part irrigated daily with an antiseptic solution. If the disease extends to the inner surface of the rib, treatment is rarely successful.

In every region of the thorax punctured wounds have a tendency to sinus formation, hence it is necessary to watch for the early signs of this complication, and to employ the curette freely when a purulent discharge persists and the interior of the wound shows the smooth lining characteristic of sinus.

Another point worthy of notice is that in the case of penetrating shaft wounds between the shoulder and the thorax or through the caput muscles important nerves may be injured, and various forms of local paralysis may result.

In the treatment of sinuses in this region the risks from hæmorrhage occurring as the result of severing large vessels during the surgical procedure must not be overlooked. Recurring hæmorrhage is not uncommon from the operation wound in such cases, when the animal is exercised, even within two weeks following the procedure, and when not due to infection is probably due to the movement and tension exerted on a vessel in which perfect occlusion by blood-clot has not taken place.

In cases where perforation of the thorax has occurred serious consequences may result, such as injury to the lung, hæmorrhage, pneumo-thorax, hæmo-thorax, pleurisy, and pneumonia.

Pneumo-thorax signifies the presence of air in the pleural cavity. The air may enter through a wound in the thoracic wall, or may come from an injury to the lung. In the case of a wound of considerable size in the chest-wall air is drawn in through the opening during inspiration and expelled during expiration, and collapse of the lung usually takes place. In a wound of smaller extent the opening may be partly or entirely closed during expiration, and air is forced into the connective tissue in the vicinity, causing surgical emphysema.

Hœmo-thorax signifies the presence of blood in the pleural cavity. It may proceed from rupture of blood-vessels in the thoracic wall, or from injury to the lungs or even the heart. When extensive hæmorrhage takes place death occurs rapidly from asphyxia due to compression of the lungs.

In cases of injury to the lung, a blood-stained discharge from the nostrils is generally observed. In the case of an extensive wound in the thoracic wall, a portion of the lung may protrude from the opening.

Even in wounds of small extent the prognosis must always be guarded, as septic pleurisy may develop.

Treatment.—Bleeding vessels must be ligatured, and the wound thoroughly disinfected and drained as far as is possible, care being taken that the antiseptic fluid does not enter the pleural cavity. The wound should be plugged with a tampon of gauze soaked in an antiseptic solution and the part covered with a thick layer of cotton-wool, kept in place by a broad sheet fixed round the chest, and changed daily. Pneumo-thorax does not require any treatment, as in favourable cases the air becomes absorbed. Similar remarks apply to surgical emphysema.

Should septic pleurisy set in, the case may be regarded as hopeless.

Wounds of the Abdominal Wall.—These are of comparatively common occurrence in veterinary practice, especially in horses. The common causes are: injury from a shaft of a vehicle, kicks, thrusts or gores from horned cattle, puncture or laceration from an animal becoming impaled while endeavouring to jump a gate.

The nature and gravity of the injury vary according to the character of the object by which it has been inflicted, and the force of the impact. Thus in some cases an extensive contusion may result accompanied by extravasation of blood; in others the abdominal wall is ruptured, but the skin remains intact; while in others again both skin and muscles are perforated, with or without perforation of the peritoneal cavity and prolapse of intestine. In some instances the internal organs are injured.

Dealing first with *contusions* or *bruises* of the abdominal wall, we may point out that not infrequently the resulting swelling may be very extensive, and there may be considerable difficulty in differentiating between it and a case of perforation of the abdominal cavity accompanied by prolapse of the bowel but without involving the skin, which lesion is termed ventral hernia.

As a recent ventral hernia is accompanied by a diffuse swelling, it is advisable to defer giving a definite opinion as to the nature of the case until the inflammatory symptoms have been reduced by fomenting. Even then it is wise, before venturing to make incision, to explore the swelling by means of a small trocar and cannula. If the case be one of hernia the presence of intestine can be detected after the fluid has been evacuated by the instrument. If a large amount of bowel be present the instrument will enter the viscus, and a flow of intestinal contents will issue from the cannula. Having determined that the case is not one of hernia, an incision should be made in the most dependent part of the swelling, and the contents evacuated. The cavity is then irrigated with an antiseptic solution, and a tampon of gauze inserted to facilitate drainage and prevent refilling. In cases where exploratory puncture with the trocar and cannula shows the contents to be blood, it is advisable to defer incision for some days so as to avoid the risk of profuse bleeding, as a ruptured blood-vessel is present.

In some instances an abscess develops as a sequel to contusion of the abdominal wall; the presence of pus is confirmed by an exploratory puncture with the trocar and cannula, and treatment is conducted on the usual lines, viz. free incision, thorough drainage, and irrigation.

Wounds of the Abdominal Wall without **Perforation of the Peritoneal Cavity.**—These vary from superficial laceration of the skin and subcutaneous tissues to deep wounds involving the various muscular layers forming the abdominal wall. In the treatment of superficial lacerated wounds ordinary surgical principles apply; strong silk sutures are necessary, and careful attention should be directed to providing efficient drainage. In punctured wounds sutures should not be employed.

In the case of deep lacerated wounds there is a tendency to the formation of pockets between the muscular layers, and in order to prevent accumulation of pus it is necessary to make suitable incisions for drainage. The wound should then be carefully examined, all loose shreds of tissue removed, and bleeding vessels secured; thorough irrigation is next carried out, and finally suturing. It is advisable to suture the deep layer of muscles, first so as to afford support and thus prevent the subsequent occurrence of hernia. Strong silk forms the best suture material, and in carrying out the procedure attention should be directed to providing adequate drainage. The skin and superficial layer of muscles are next sutured, and it is of advantage to insert as well a sufficient number of sutures of relaxation, or tension sutures (see p. 571).

The after-treatment is to be conducted on general surgical principles. Whenever possible it is of advantage to apply a large pad of cotton-wool to the wound, and to secure it in position by means of a broad sheet of linen passed round the body.

Wounds of the Abdominal Wall associated with Perforation of the Peritoneal Cavity.—Wounds coming under this heading vary in their character and extent. They may be of the punctured or lacerated type, and may be accompanied or not by prolapse of the bowel, and with injury to the latter or to other internal organs. Every wound which perforates the peritoneal cavity must be regarded as very serious, even though it be a puncture which may appear insignificant at first sight. The frequent occurrence of septic peritonitis in the horse as the result of accidental wounds of the peritoneum is well known. In cattle, on the other hand, the resistance to infection of the peritoneum is well marked. It must be remembered that infection gains entrance at the time the wound is inflicted, and the difficulty of carrying out disinfection and of providing efficient drainage is quite apparent.

In spite of the high mortality from penetrating wounds of the peritoneum in the horse treatment should be attempted, except in cases where extensive prolapse of bowel occurs, with injury of the walls of the viscus either caused by the struggles of the patient or by the original accident. Many cases are recorded in which recovery took place although the outlook was anything but favourable.

In cases not associated with prolapse of the bowel the wound should be disinfected as thoroughly as possible, and sutured in two layers, viz. a deep and a superficial. For details see article on "Surgical Technique." Support should be given by means of a large layer of cotton-wool and a linen sheet fixed round the body.

When prolapse of bowel has occurred, and treatment is deemed worth attempting, the extruded intestine should be protected from injury by enclosing it in a clean linen sheet fixed round the body. The horse is then carefully cast on a clean straw bed covered by a sheet, and chloroform administered. Except in cases where the wound is situated high up on the flank it is necessary to secure the animal on his back. The extruded intestine is then carefully cleansed and disinfected, the wound being previously packed with sterilized towels, so as to prevent the fluid from entering the peritoneal cavity. If a wound be detected in the bowel itself it must be closed by means of Lembert's sutures (see article on "Surgical Technique" for details of this procedure). If bruised or injured omentum be present a ligature is applied above the injured part, and the latter is excised. The sterilized towels are then removed and the intestine is then returned to the abdominal cavity, and the wound sutured according to the method already mentioned.

Should symptoms of peritonitis arise, viz. high fever, loss of appetite, a "drawn-up" condition of the abdominal walls succeeded by tympanites, a wiry pulse, accelerated respirations, and a haggard expression of countenance, the animal should be destroyed as hopeless.

In some cases a local peritonitis is set up associated with adhesions between the bowel and the peritoneum in the vicinity of the wound, and generally with a fatal termination.

Wounds of the Hind-quarter.—The commonest site for wounds in the region is the vicinity of the ischium (the buttock), and the usual cause is a kick inflicted by another horse. In some cases a contusion results with extensive soft swelling containing either blood or serum, in others a lacerated wound is caused by the calkin of the shoe. A very extensive wound may be caused in this region by a gore from a cow's horn or from barb-wire. Cases are also met with in which a deep punctured wound of the inside of the thigh is caused by a stake while the horse is jumping a fence. We have seen a deep lacerated wound caused by a hook becoming embedded in the skin of the lumbar region while the animal was being harnessed to a cart; this wound extended from the right side through the gluteal region and terminated in the buttock of the left side.

Treatment.—In the case of contusion accompanied by a serous swelling or a hæmatoma a free incision should be made at its lowest point, so as to empty the cavity of serum and blood-clot and provide drainage. The part is then irrigated daily with an antiseptic solution and a tampon of gauze inserted to keep the sac from refilling.

In the treatment of open wounds of this region ordinary surgical principles should be adopted. Special care should be directed to affording proper drainage. In wounds extending in a downward direction there is often considerable difficulty with reference to drainage, but free openings and counter-openings must be made when necessary, and thorough irrigation carried out. Sutures composed of a strong soft material or of tape must be employed with discretion, care being taken that drainage is not interfered with. The strong fascia which abounds in this region tends to form pockets in which pus accumulates, and these should be slit open with the knife.

Open Stifle Joint.—The treatment of this injury is to be conducted on similar lines to those mentioned under "Open Joint." In the majority of instances septic arthritis develops and the case is hopeless. It must be remembered that septic inflammation arising in wounds of the tendon sheaths of the flexor metatarsi and extensor pedis may extend to the stifle joint.

Wounds of the Lower Thigh or Tibial Region.—The region extending from the stifle to the hock is a common site for wounds, the usual causes being kicks, prods from a stable fork, and lacerations from barb-wire.

Owing to the strong fascia which covers the tibial muscles complications are likely to be associated with wounds of this region, especially punctured wounds. Subfascial cellulitis, extensive suppuration, and necrosis of fascia may occur, also a portion of the muscular tissue is apt to protrude through the opening in the fascia and to form exuberant granulations. Marked lameness is present, and a tense painful swelling extends up the limb. Unless early and free incisions are made, cellulitis may lead to extensive necrosis and terminate in general septicæmia. Another complication which may be encountered in cases caused by severe kicks is periostitis of the tibia and even fracture of that bone.

Treatment.—The wound should be carefully examined and proper drainage provided. In most cases it will be necessary to divide the fascia freely in a longitudinal direction, so as to release tension and permit of thorough irrigation of the wound. When marked swelling and pain are present, fomentations are indicated. Exuberant granulations should be checked by the application of powdered sulphate of copper. Sinus formation is not uncommon as the result of wounds in this region, hence the early evidences of this lesion should be looked for, and if present, a free incision and the use of the curette are imperative to prevent the occurrence of this troublesome sequel.

In some cases a small portion of bone is chipped off the tibia by the injury, and its presence is detected by digital examination of the wound. Until this is removed healing will not take place.

Here we may remark that, in the case of wounds due to kicks on the inner aspect of the tibial region, it is always advisable to place the horse in slings, as owing to the strong fascial covering of this bone a fracture without displacement may occur at the time of injury and cannot be detected. If the animal is permitted to lie down or is put to work displacement occurs, and the patient will then have to be destroyed, whereas if placed in slings a useful recovery is more likely to follow.

Wounds of the Hock.—These are observed as the result of kicks, punctures from a stable fork, or from a sharp stone or gorse branch, while jumping a fence, also from barb-wire.

In the case of lacerated wounds, which do not involve the joint, treatment is conducted on ordinary surgical principles. Wounds in front of the hock with much bruising of skin are difficult to heal in consequence of the constant movement of the joint, and there is a tendency to the formation of exuberant granulations. In such cases it is advisable to place the animal in slings, so as to ensure rest to the joint; the excessive granulations must be checked by the judicious application of powdered sulphate of copper.

Open Hock Joint.—This is to be treated on the lines mentioned under "Open Joint." If the true hock joint be opened and septic arthritis develops the outlook is very unfavourable and few cases make a useful recovery. In the case of the other joints comprising the hock more favourable results are obtained, provided early treatment be adopted.

General Remarks on the Treatment of Wounds in Cattle

Similar surgical principles to those adopted in horses apply to the treatment of wounds in cattle. As, however, cattle are seldom treated in a veterinary infirmary we have to depend on the owners or attendants to carry out the necessary dressing of wounds; consequently, simplicity in the procedure associated with measures likely to overcome the effects of lack of surgical cleanliness are essential. After the practitioner has provided ample drainage he must rely on the application of antiseptic agents to promote healing and to prevent the occurrence of septicæmia. Cases do far better on pasture than in the cow-house, as it is practically impossible to render the surroundings sufficiently clean in the majority of instances. Fortunately, cattle are far more resistant than horses to septic infection, and this fact is well shown in the favourable course manifested in many instances of wounds of the abdominal cavity occurring in bovines.

The most common injuries met with in cattle are punctured wounds arising from animals horning each other. In the abdominal region injuries from this source may produce either a large contusion or hæmatoma, a rupture of the muscles without perforation of the skin associated with the presence of a hernia, or a wound involving skin, muscles, and peritoneum, with or without prolapse of internal organs. Provided the prolapsed viscera are not injured, treatment of these cases can be undertaken in cattle with more hope of success than in the horse. The principles of treatment are similar in both instances.

General Remarks on the Treatment of Wounds in the Dog

Many cases of accidental wounds in the dog originate from bites inflicted during fighting. Such wounds vary in extent and gravity from a simple puncture of the skin to a serious laceration of the tissues. Again a punctured wound caused by a bite may extend very deeply, and unless surgically treated is likely to bring about septicæmia.

Wounds due to bites should always be regarded as septic, and it is essential to provide free drainage and to disinfect the parts thoroughly. Sutures should never be employed in such cases, except in instances where an extensive laceration of the skin is present, or an organ such as the ear is torn. In a deep puncture occurring in the forearm or thigh infection is likely to spread along the tendon sheaths and fasciæ unless a free incision is made and thorough disinfection carried out.

The tendency for the dog to lick his wounds is well known, and except in the case of penetrating wounds of the abdominal cavity which have been surgically treated and sutured it is generally admitted that healing is hastened rather than retarded by the licking process. With regard to the precautions necessary to prevent the animal from interfering with wounds, in which it is desirable to secure healing by primary union, the reader is referred to the article on "Surgical Technique." For information on the indications for applying surgical dressings in the treatment of wounds in canine practice the reader is also referred to the same article. Penetrating wounds of the abdominal cavity are treated on similar lines to surgical wounds in this region, but with a far greater degree of success than is the case in equine practice.

One point which must be remembered in connection with the employment of antiseptics of the coal-tar series while dressing wounds in the dog and cat is the danger of absorption and the production of toxic effects. By employing Dakin's solution this risk is obviated.

E. W. H.

WAR WOUNDS

In the field two classes of wounds are met with:

(1) Those due to hostile action.
(2) Those arising from accidental causes.

Under the former heading one meets with injuries produced by mechanical agency, varied in its nature, operating either in close proximity to or at a great distance from the object against which it is directed.

The resulting wounds may be divided into:

(1) Gunshot wounds.
(2) Bomb wounds.
(3) Sabre, lance, or dart wounds.

Gunshot wounds fall naturally into two subdivisions: (*a*) Bullet wounds; (*b*) shell wounds.

Bullet Wounds.—Bullets may be pointed or flat-nosed. Amongst civilized nations the type in common use is one with a sharply pointed nose; this shape greatly adds to the powers of penetration.

A bullet which is nearly spent will strike a part and inflict a bruise or it may penetrate the skin. Examination will reveal swelling and a degree of soreness, whilst palpation may discover the position of the bullet. On the other hand, if fired at a moderate range and should it not encounter any hard obstacle, the bullet will pass through thick groups of muscles, such as are met with in the region of the neck, forearm, or behind the tibia, through the second layer of skin, and will continue in its course.

The symptoms exhibited in this case will be local inflammation, pain, swelling and soreness. The wound caused by exit will invariably be larger than that of entrance.

Detonation of the explosive charge generates a very great degree of heat which probably renders the missile aseptic. Bullet wounds may therefore show little sign of infection, and under the conditions above described a favourable termination may ensue. On the other hand, hair, mud, and portions of harness may be carried into the tissues, resulting in suppuration sometimes accompanied by systemic disturbance.

A large blood-vessel may be struck and copious hæmorrhage may ensue, which however, in many cases, ceases of its own accord. In rare instances nerve trunks are severed or bruised, resulting in paralysis of the muscle groups supplied by the motor fibres of this particular nerve; in the event of bruising such paralysis may wear off in the course of time.

In the case of a long bone being struck by a bullet which does not penetrate it but merely causes local pressure the local symptoms may subside, but if the bullet be not extracted it will sooner or later set up inflammation, resulting in abscess formation, and upon operation the foreign body will usually be found resting on the floor of the abscess cavity.

In many cases the bone will be fractured. This fracture may assume various forms: a piece may be chipped off, and if not removed along with the bullet will lead to a chronic discharge, characterized by the smell of dead bone. Sometimes the part will heal, but eventually the fractured part will be cast off from the parent bone after a long period, resulting in swelling, pain, signs of local inflammation, and either abscess or sinus formation.

Should a joint be wounded the case is usually serious, as partial or complete fracture of one of the bones of the joint usually occurs, and in addition the synovial capsule will be bruised or lacerated and open joint will result.

In the region of the sinuses of the skull the entrance-wound will be evident and a degree of hæmorrhage will occur from one or both nostrils, in some cases very severe. Later, a profuse yellowish nasal discharge will appear, though this tends to disappear in time, especially in cases in which the bullet has made its own exit. Sometimes the missile will become lodged in some part and recovery may occur, but in other cases it may lie free in one of the sinuses and set up irritation, or pieces of bone may be driven into the sinus or become necrotic, producing symptoms similar to those seen in infected sinuses.

In the region of the thorax bullet wounds may be followed by no ill-effects, whilst on the other hand they may prove fatal according to what particular organs are encountered.

Wounds of the abdominal region are much more serious. Provided that the bullet has penetrated within the peritoneal cavity symptoms of acute peritonitis may be observed in the course of a few hours. The head is held close to the ground, breathing appears difficult, and a frothy discharge issues from the mouth and nostrils. The visible mucous membranes show marked injection and there is a considerable rise in temperature. Death is the usual termination.

Sometimes the bullet is extracted from the cartridge and turned round before being fired, resulting in a worse wound than even those caused by flat-nosed bullets. The principle of these latter is that the lead on striking the target flattens out and produces a large wound. Whole pieces of tissue or bone may be shot away.

Treatment.—In the simpler cases, such as in muscular wounds, when the bullet can be located beneath the skin the entrance should be enlarged and bullet-forceps employed to effect removal. Long hairs should be clipped off and the skin rendered as nearly aseptic as conditions permit. Whenever possible the artificial opening should slope from the site of the bullet in a downward direction, thus facilitating drainage. After removal the parts should be swabbed out with a warm antiseptic solution and then plugged lightly with gauze steeped in the same. In wounds involving muscular tissue from which the bullet has made its own exit the treatment is similar, but when the passage is long and tortuous it is rarely possible to practise complete disinfection; but as, previously stated, bullets seldom carry infection, resolution in many cases is merely a matter of time. It is therefore doubtful if one is justified in interfering to any extent. Probably medicated fomentations, gentle walking exercise, and attention to hygiene will assist nature sufficiently. Frequently, when the bullet remains lodged in muscular tissue, it is advisable to leave it severely alone, as in many cases healing will occur. There are many animals working to-day which carry bullets embedded in their muscles without any apparent inconvenience.

In some instances harness and other foreign bodies are carried in along with the missile.

This necessitates enlarging the wound to provide drainage. Probing may aid in their detection. When the channel has become infected a discharge will make its appearance, accompanied in some instances by fever and loss of appetite. The discharge itself tends to enlarge the channel, and after a few days it will materially assist in the location of the missile.

When a bullet becomes lodged in the region of a bone and is not extracted it occasionally happens that, sometime after the animal has returned to work, local symptoms arise with abscess formation. In this case the abscess should be allowed to mature, and upon being opened close to the floor of the cavity the missile will be usually found lying free.

Whenever possible the bullet should be removed, but owing to its great powers of penetration it is sometimes most difficult, especially when it has partly or entirely perforated a long bone. A generous use of the knife will be required in many instances, but it should be borne in mind when making these incisions that drainage is essential.

All foreign bodies and splinters of bone should be removed, and this will necessitate the use of bullet forceps with a strong gripping head. In the event of a long bone being punctured the exit will have to be enlarged, and after removal of the bullet antisepsis should be practised. Antitetanic serum should in all cases be administered.

In the event of a joint being involved prognosis is unfavourable, and the most we can hope for is a stiff joint, but under war conditions treatment is seldom attempted.

When hæmorrhage occurs from the sinuses of the head, the nostrils should be plugged with pledgets of gauze or lint, to each of which a string or tape is tied to effect removal. Suprarenal extract may be used locally and *via* the blood stream. Tracheotomy may be necessary. Later, infection of the sinuses may result in chronic nasal discharge, which may necessitate trephining, although sometimes it is intermittent in character and produces no ill-effects.

Abdominal wounds require quietude and hygienic surroundings. In the event of recovery a long period of convalescence should be allowed.

In all cases the use of antitetanic serum should be insisted upon. If fresh, 1500 units should be injected subcutaneously and repeated about every six days until the wound is well on the way to recovery.

As a cleansing agent for infected wounds hydrogen peroxide is useful. As germicides the hypochlorites rank high and have given very excellent results in the treatment of gunshot wounds ; septic, offensive wounds speedily take on a healthy appearance, smell disappears, a free flow of lymph is obtained, and the walls rapidly granulate.

A 5 per cent solution of hypochlorous acid is a convenient form of preparation. Take of the liquor calcis chlorinatæ, *B.P.*, 25 drachms, dilute with 1 pint of water and add $1\frac{3}{4}$ drachms of boric acid. Liquor calcis chlorinatæ is prepared by dissolving 15 ounces of chlorinated lime in one gallon of water.

The solution of hypochlorous acid should be allowed to stand for twenty-four hours and then should be filtered. It deteriorates after a few weeks.

Hæmorrhage from bullet wounds is seldom very serious unless large vessels are severed. Whenever possible it is advisable to ligature the artery, or failing this, to plug with gauze or wool and suture. The packing should be left in position for two days at least, as secondary hæmorrhage is liable to occur through infection and breaking down of the clot.

Shell Wounds.—Shell wounds may be primarily divided into two types :

(*a*) Shrapnel.
(*b*) High-explosive.

Shrapnel Wounds.—These shells consist of a number of large and round bullets, sometimes intermixed with pieces of metal irregular in shape and of varying size, and of an explosive charge, contained in a shell-case.

It is the object of the gunners to cause this charge to explode some yards above and in front of the target. In addition to the impetus given to the bullets by the explosive charge, one has to add the velocity of the shell at the time of its explosion.

The bullets travel in a downward and forward direction, and they have clinging to them particles of the burnt charge. The wounds inflicted are, as a rule, of no great size superficially but they may penetrate many inches through muscular tissue unless their course be arrested by a bone.

If one attempts to probe a wound shortly after it has been inflicted, one encounters a good deal of resistance from the surrounding tissues, which tend to cling to the probe. Pieces of harness, skin, or hair may be encountered. The passage may be fairly straight or tortuous. In many cases, more especially those in which the missile has penetrated some distance, it will be impossible to reach the bottom of the wound.

Later, a yellow gelatinous discharge makes its appearance and in many cases the wound develops into a chronic suppurating sinus. The discharge materially assists in the task of locating the foreign body, it tends to break down the macerated and torn muscular tissue, and to form a channel through which a probe may easily be inserted. As a rule, there is no great difficulty in recognizing the missile itself as soon as it is encountered by the probe, but occasionally splinters of bone and cartilaginous tissue may deceive the operator.

Should the bullet, in its course, come into contact with a bone it may be thereby brought to rest, but as a rule when it hits the bone squarely it drills a hole. In the case of a flat bone, such as the scapula, perforation may be complete, but in long bones the course of the missile is usually arrested in the medullary cavity. The presence of the bullet nearly always gives rise to suppuration, and a condition of purulent ostitis may arise, resulting in systemic disturbance, and as amputation of a limb is of no practical service from a veterinary point of view, usually the animal is destroyed.

The remarks on rifle-bullet wounds apply to shrapnel as regards other parts of the body with the above-mentioned exception that wounds caused by shrapnel have a far greater tendency to suppurate, owing, it has been stated, to the presence of chemical bodies which are generated as the result of explosion of the charge.

It sometimes happens, however, that a minor wound will heal of its own accord without extraction of the piece of metal. Later this will reopen and commence to discharge, and upon examination one will find a sinus with an extremely thick fibrous wall.

Another type of shell wound is also occasionally met with. In an endeavour to bring down enemy aircraft by the use of guns both shrapnel and high-explosive shells may be fired. In the case of the former both the fuse and shell-case have to fall; in the latter the shell splits into numerous pieces or, as sometimes happens, it may be a "dud"; consequently, during an aircraft barrage pieces of metal weighing anything up to a number of pounds are constantly falling to the ground from a great height. The wounds inflicted vary somewhat; the smaller pieces, if they fall in a favourable position, cause punctured wounds and the pieces usually make their own exit.

Empty shell-cases will in certain instances cut away a circular piece of tissue a foot or more in length; such wounds are seen in the region of the scapula and ribs. On the other hand, it is more usual for the animal to be killed outright.

Shell Wounds.—High-explosive shells break up into a number of pieces of very varying size, hence the resulting wounds may be small punctures or they may carry away large pieces of skin and flesh similar to those described under shrapnel wounds. The rifling of the gun, however, gives the projectile a "spin," and this being retained to a certain degree by the fragment results in a tortuous channel through the tissues. Portions of hair, skin, and harness usually accompany the piece of metal, and the walls of the channel will be found badly bruised and very irregular.

As in the case of particles of shrapnel, extraction is very difficult, but is rendered less so in the course of a few days when the presence of a copious discharge will lead to the detection of its position. The provision of drainage is very important, but is often a matter of difficulty owing to the depth of the wound and its relation to important structures. When enlarging a wound of this nature, the incision should, whenever possible, be carried from within outwards in a downward direction. Other treatment must follow general principles.

Bomb Wounds.—The causal agents in this instance are dropped from aircraft, and in some types the splinters tend to travel low to the ground and in some instances nearly parallel to it. A great many of the wounds met with are therefore in the region of the limbs and hoofs. The wounds themselves resemble those met with as a result of high-explosive save that fractured and shattered limbs are more common.

Hand-grenades cause wounds of a similar type, but they are usually less severe as the splinters are smaller.

Sabre Wounds.—Owing to the nature of the instrument inflicting the injury the resultant wounds tend to the form of an incision or a puncture. Hæmorrhage is severe, in some cases, at the time of infliction.

Lance wounds take the form of punctures, sometimes of considerable depth. In some cases the head of the lance snaps off and remains *in situ*.

Dart Wounds.—Since the advent of aerial warfare a new form of attack has come into existence, namely, the dropping of arrow-shaped metal darts from a considerable height.

The darts vary in size. If, by any chance, one hits the object at which it is aimed, it may penetrate its entire depth and find lodgment in the ground. It therefore follows that most wounds of this nature cause death. Some consist merely of punctures or long gashes, comparatively superficial, which admit of ordinary surgical treatment.

Miscellaneous War Wounds.—Apart from the types of wound previously discussed, others may be met with which may be purely accidental or the result of traps deliberately set by an enemy.

Amongst accidental wounds we must include those caused by picked-up nails, which are very common, especially among horses travelling over fascined roads.

Barbed wire is responsible for a large number of injuries. The breast, limbs, and heels are the parts usually injured. The wounds may be either simple incised wounds, usually the result of the horse galloping through the stretched wire, but more commonly triangular pieces of skin are torn away or left hanging in close proximity to each other. It also frequently happens that the animal becomes entangled in the wire and is cast among it, with resulting injury to various parts of the body.

Pickets of wood or iron pointed at the top, and used for fixing barbed wire, inflict ugly gashes and punctures, more especially in the regions of the limbs, breast, and abdomen. Sheets of galvanized iron and empty tins laid upon the country inflict nasty wounds of the coronet and tendons, as also does kicking in stables built of the same material.

Kicks, more especially when frost-cogs are used, result in serious punctures and often in open stifle, elbow, or hock joint.

Lacerated and incised wounds of the coronets and heels are common among animals working on tramways, and in some instances, through the heel of the shoe becoming entangled, it may be pulled off and may result in contusion of the sole, a badly-broken wall, and occasionally puncture of the sole caused by the horse treading on the toe-clip.

Collision with vehicles, lorries, and other objects may result in lacerated wounds. Punctured wounds, principally of the thorax, may arise from contact with the pole of another vehicle. Crushed hoof not uncommonly results from being run over. Cartridges left lying about often cause puncture of the sole; frequently an open navicular joint is the sequel.

Amongst the wounds caused by traps laid by the enemy staking is perhaps the commonest, especially by concealment of the stakes in prepared pits with false roofs laid on the top.

Another form is punctured sole, resulting from the use of specially designed pieces of metal scattered on the road of cavalry or transport. Such pieces are designed from thickish metal, from which a V-shaped piece projects upwards from a metal base. R. H. S.

GAS POISONING

Gas may be liberated from cylinders and propelled over the enemy lines by the aid of the wind, but the more common method is to compress the noxious fumes in a casing in the shape of a shell, which is then fired in much the same way as an ordinary shell.

The essential feature of the gas is that its specific gravity must not be lower than that of the atmosphere, otherwise diffusion would be too rapid to produce the desired effect; further, it must be of an irritant or poisonous nature, so as to produce the greatest inconvenience or possibly death to those with which it comes into contact.

Different types of gas have made their appearance from time to time; thus some appear to exert a particular effect upon the ocular apparatus, producing an intense smarting sensation and a copious flow of tears; these are known as lachrymatory gases. Others, from their irritant effect upon the cutaneous membranes, have been termed "mustard gas."

Chlorine was at one time largely employed, but its use has now been partly superseded by the production of various other gases, no doubt considered more objectionable.

Since many of these gases are irritant or caustic, more especially when they come into contact with moist surfaces, it follows that the respiratory apparatus would be amongst the first to suffer; also in animals those parts not well protected by hair, such as the perinæum.

In a typical case of gas poisoning, provided the animal has been exposed for some little time, the following train of symptoms will be observed:

Loss of appetite, buccal mucous membranes blistered, nostrils and Schneiderian membrane excoriated, and in many cases the lips, perinæum, and anus also. The skin is hot and painful, and after a few hours shows numerous cracks and fissures from which an exudate commences to ooze and runs off the hair in drops. In the course of a few days the condition of the buccal mucous membrane and skin will commence to improve, but respiratory symptoms usually present themselves, as marked by shallow jerky respiration and slight mucoid discharge from the nostrils. The breath then becomes fœtid and characteristic of gangrene of the lungs. Exudate may appear in the chest, with œdema of the breast and fore-limbs. Gangrene of the lungs then becomes more marked, and death may ensue in from seven days onwards.

Cases of gas poisoning may be divided into acute and subacute. Some animals are more susceptible than others, as is evidenced by the fact that amongst animals exposed for an equal period some get off very lightly whilst others develop fatal symptoms.

Instances have been observed in which the symptoms are chiefly confined to the respiratory organs. In the early stages these simulate congestion of the lungs. Thus, there may be accelerated and laboured breathing and an appearance of acute distress, with the head held low and dilated nostrils, from which a frothy or mucoid discharge appears. The visible mucous membranes assume the appearance seen in congestion of the lungs. The temperature is elevated somewhat.

Irritation of the respiratory mucous membranes is evidenced by a painful hacking cough, the discharge assumes a yellow colour and becomes purulent and offensive. Should the patient survive long enough gangrene usually supervenes.

Treatment.—Prognosis must depend upon the degree to which the animal has been exposed.

Minor cases tend to recover spontaneously. Absolute rest is essential, diet should be attended to, and the appetite tempted with carrots and similar food-stuffs.

Hygiene plays an important rôle; warmth and a good supply of fresh air are absolutely essential.

In certain experimental cases, bleeding followed by intravenous injections of physiological saline solution has given encouraging results. The inflamed skin and mucous membranes must be treated on general principles. Carron oil or similar dressings may be used for the skin.

In the event of recovery, a long convalescence is essential. R. H. S.

BURNS AND SCALDS

Cases of accidental burning or scalding are not common in veterinary practice. Those met with are usually the result of the spilling of hot liquids or of the use of fomentations at too high a temperature or of insufficiently cooled poultices. Dogs and cats sometimes receive burns from hot cinders; occasionally the coat of long-haired dogs has been known to ignite through too close contact with an open fireplace. The burning down of stables has at times been responsible for very severe cases of burning among horses apart from many deaths. Malicious burning is not unknown, and several cases have found their way into the police courts, particularly with reference to the use of flame as a "cure" for jibbing horses. Unskilful branding sometimes produces severe injury.

All portions of the body are by no means equally susceptible to the application of heat, and fluids or solids of moderately high temperature, which would cause vesication of certain skin areas, produce no ill-effect in others. The axillæ, ventral surface of the body, lips, and nostrils are very subject to injury by heat. Dogs frequently suffer from cracking and desquamation of the skin of the muzzle through constantly lying in close proximity to a fire-place.

Three classes of burns and scalds are recognized in relation to their severity.

(1) Those which produce mere reddening of the skin. The condition is only one of short duration, but may be attended by considerable pain. It may be produced by overheated poultices or fomentations, which may, however, be sufficiently severe to produce scalds of the second class, to be presently described. The reddening of the skin in most cases soon subsides, but if the heat employed has been sufficient to injure or destroy the epidermal cells, desquamation follows.

(2) Those which are attended by vesication. The vesicles make their appearance almost immediately in the majority of cases, though sometimes they may not become evident until several days have elapsed. They result from exudation of serum from the cutis. The condition is an exceedingly painful one, particularly when the vesicles have burst or become torn or rubbed. Cold air causes extreme irritation of the exposed true skin, and if the affected area be of large extent so-called "shock" may result, particularly if the injury be to any portion of the trunk.

In animals, owing to the difficulty of maintaining asepsis, and of controlling the animals' desire to lick or rub the parts, infection almost always occurs and leads to suppuration.

(3) Those in which the whole thickness of the skin is destroyed or rendered necrotic.

Large areas of skin and underlying tissues slough away, leaving extensive wounds which heal only after many weeks or months owing to the impaired resistance of the surrounding tissues produced by the degree of heat. Suppuration is always extensive and may be accompanied by crops of secondary abscesses in the tissues immediately surrounding the injury.

Dogs and cats occasionally suffer from this class of injury as a result of accidental spilling of boiling water from kettles, etc. A large piece of skin may then slough from the part affected, usually the back, and owing to the amount of fat usually underlying this part gangrenous changes occur with the discharge of fœtid pus and the shedding of necrotic fragments.

Shock more often follows this type of burn or scald, but is not nearly so common as in the more highly-strung human subject. The recognized symptoms are shivering, cold extremities, feeble pulse, dyspnœa, followed by coma and death, or in some instances by nervous excitement and delirium. The most marked post-mortem lesions are those of congestion of the brain and œdema of the lungs.

Treatment.—Cold applications relieve the burning sensation, but to produce a lasting effect their action must be continuous. A warm dressing, such as a paste prepared of finely-powdered kaolin rubbed down with water at a temperature of about 120° F., at first increases the sensibility but after the first few minutes diminishes the pain, and it has been found that by applying subsequent dressings each at a slightly lower temperature than the last the burnt or scalded area can, after a moderate length of time, be left exposed to the air without causing pain.

As an emergency dressing to relieve the acute pain experienced immediately upon the receipt of a burn, a thick dressing of flour or starch may be applied or even the white of an egg. Carron oil when available is a well-known and useful application, and an emulsion of lime-water and milk much resembles it and is preferred by many surgeons. Soap liniment, treacle, or warm vinegar have also been recommended by various authors. A solution of chloretone in a bland oil or liquid paraffin is now much employed.

After the formation of vesicles, further treatment will be required. If of small size and not too tense, wrapping in wool soaked in any of the above-mentioned applications may be resorted to, but should the vesicles become confluent and extensive or very tense, they should be pricked with a surgically-clean needle. An antiseptic dressing should then be applied such as a solution of chloretone in oil, to which a little oil of eucalyptus may be added, and the parts should be thickly padded with cotton-wool and a light bandage applied over all. This dressing should not be disturbed for several days unless the wool becomes saturated with lymph or other discharge. Upon removal, if still aseptic, mild astringent lotions should be employed. Zinc sulphate gr. ii. to ℥i. water answers this purpose quite well.

Cases of the third type, associated with death of the part and extensive suppuration, should be treated as open wounds. Shreds of necrotic tissue may be removed by means of curved scissors. Frequent fomentation with warm saline solution and an occasional application of tinct. iodi. give good results. After suppuration diminishes and the parts appear more healthy they should be powdered thickly with consecutive layers of dry antiseptic dressing, such as a mixture of zinc oxid., acid boric, and starch until the whole is covered by a thick scab.

Shock as indicated by collapse must be treated with stimulants, whereas nervous excitement may be controlled by sedatives as pot. bromid. or chloral hydras.

In an endeavour to relieve the congestion commonly occurring in the brain and lungs, intravenous injections of adrenalin might be found useful.

To prevent the excessive contraction which often occurs after the healing of large burns or scalds, the parts should be kept stretched as much as possible during the latter portion of their healing and frequently smeared with an oily dressing. Splints may be of assistance in some cases, but daily manual manipulation is usually sufficient. In the larger animals a number of elliptical pieces of skin may be excised on either side of the wound in the line of contraction and in healing will exert a " pull " upon the cicatrix. To avoid adhesions, contiguous parts of the body such as the arm and breast may be kept apart by the application of pads of oiled wool held in position by means of bandages. Skin grafting has not as yet found many exponents among veterinary surgeons, but one or two successful cases have been reported.

R. H. S.

VETERINARY EXAMINATION OF HORSES AS TO SOUNDNESS

Horses sold as sound are examined to ascertain if they are free of those diseases or defects of structure and action which are commonly regarded as unsoundnesses. Horses, stallions, and mares sold as sound for breeding purposes are examined to discover if they are free of hereditary unsoundness and of any other defect which is likely to interfere with their usefulness in reproduction. The diseases or defects recognized as hereditary are : cataract, whistling or roaring, ringbone—high or low—sidebone, bone spavin, navicular disease, shivering, stringhalt, and defective genital organs. Horses sold as serviceably or practically sound are examined to determine if they are capable of regularly performing the ordinary work of the class (harness, draught, saddle, or hunting horse) to which they belong. Horses sold at repositories and described in the catalogues as " quiet to ride or drive," " quiet in harness," " good worker," etc., are examined to discover if they answer their description as defined by the conditions of sale.

The examination may be complete, or partial and restricted to the limbs and action, the wind, eyes, age, height, or health of the horse, according to the terms of sale, or the vendor's warranty, representation, or description of the animal.

Many if not most horses are unsound, but every unsound horse is not a useless animal and every sound one is not a desirable purchase. A sound horse may have certain vices which render it unsafe or unreliable ; it may be " a slug," or the conformation of its limbs may be so faulty as to preclude the probability of its remaining sound at work. Very few horses over five years old are absolutely sound. Many are technically unsound, that is, they have one or several defects which, though detracting from their market value do not seriously interfere with their serviceableness. Others are distinctly unsound in limb or action, in eyes or wind, or in some internal organ.

In law, soundness is akin to perfection, as the leading judgment, that of Baron Parke (1842), plainly indicates : " A man who buys a horse 'warranted sound,' must be taken as buying him for immediate use, and has a right to expect one capable of that use, and of being immediately put to any fair work the owner chooses. The rule as to soundness is, that if at the time of sale the horse has any disease, which either actually does diminish the natural usefulness of the animal, so as to make him less capable of work of any description, or which in its ordinary progress will diminish the natural usefulness of the animal, or if the horse has either from disease or accident undergone any alteration of structure, that either actually does at the time, or in its ordinary effects will diminish the natural usefulness of the horse, such horse is unsound."

Litigation in connection with horse-buying is seldom commendable and never economical or wholly satisfactory to either party to the dispute, though probably "horse causes" will continue for many years to furnish more or less interesting and often remunerative employment to lawyers and veterinary surgeons.

Disputes nearly always have their origin in the discovery subsequent to purchase by the buyer of the horse of a real or perhaps an imaginary unsoundness which the warranty may be supposed to cover. Men, astute enough in other transactions, in buying a horse sometimes err in failing exactly to comprehend the terms on which they make the purchase. They may not fully understand the significance of the vendor's description or warranty, which often is an oral one. They like the horse, and, having for the moment much faith in human nature, rather hurriedly conclude a bargain which may lead to disappointment and considerable vexation.

According to their terms warranties may be general, special, or express. Warranties of age, height, freedom from vice, and others covering a patent or other defect for a stated period are recognized. Warranties may be given in writing or orally, but generally a written warranty is more satisfactory than an oral one, because, in the event of a dispute regarding the terms of an oral warranty, the actual words employed must be proved, and as a rule the evidence is strongly contradictory. A general warranty of soundness implies that the horse is sound and fit for immediate use. Its terms may be extended to include freedom from vice and blemishes, but otherwise a general warranty does not cover patent, obvious, or palpable defects like chipped knees, bumped or worn joints, scars and other blemishes which a buyer may be presumed to see for himself. A buyer who may be in doubt regarding a visible defect should protect himself by having it covered by a special warranty. Dealers, too, when selling horses with patent defects would frequently avoid vexatious correspondence and its results by adding to the general warranty of soundness a clause excepting the obvious defects. Sometimes the nature or importance of a patent defect in the horse is discussed by buyer and seller after completion of the bargain, but, according to the ruling of Baron Bramwell, "The warranty being a written document cannot be altered by parole. I can understand it can be limited by circumstances occurring at the time it was made, although in form it may be general. This does not apply to a written warranty."

Representation should be distinguished from warranty. Sometimes words spoken by the seller in praising a horse are mistakenly considered by the buyer as amounting to a warranty of soundness. "An affirmation at the time of sale is a warranty, provided it appears in evidence to have been so intended" (C. J. Holt), but representations made by the vendor as an inducement to buy are not warranties unless they form part of the bargain. "In the case of a representation to render liable the party making it, the facts stated must be untrue to his knowledge; but in the case of a warranty he is liable whether they are in his knowledge or not" (C. J. Tindall). In selling horses, dealers, and others who may not be dealers in horses, often employ extravagant language in commendation of their animals, but usually their flattering phrases are only expressions of opinion or belief more or less influenced by an earnest desire to effect the sale of a possibly useful horse at a profitable price. They should not be taken too seriously, as they are not intended and should not be accepted as a warranty of soundness. Defects of conformation, which are natural, inherited, or congenital, though sometimes very objectionable, are not covered by a general warranty of soundness. In order to constitute unsoundness the defect must render the horse less than reasonably fit for immediate use. When a horse is bought, in England, with a warranty of soundness and it prove to be unsound, the buyer cannot return it unless there is a stipulation to the effect that if the horse does not answer the warranty it can be returned; but the buyer may offer to return the horse to the seller, and if he refuse to take it back, the buyer may then sell the horse as in dispute and recover from the vendor the difference between the price paid for the horse and the amount realized from its sale at auction. The offer to return the horse should be made to the vendor within a reasonable time of the date of purchase, and it should be accompanied by a copy of the veterinary certificate of unsoundness or alleged breach of warranty. In these cases timeous discovery of the unsoundness with immediate notification to the vendor of the horse is of prime importance. A horse may become unsound in wind quite suddenly or in a few days after entering the buyer's possession; it may spring a curb or a sandcrack in its first day's work, and, if a young horse, it may fall lame from splint at any time. Three months or longer after purchase the buyer may be told that the horse has a spavin and his veterinary surgeon may certify that the defect must have existed at the date of purchase. The veterinary surgeon may be quite right, though as a rule his estimate of the duration of the spavin is not free from error. It is extremely difficult if not impossible for any one to determine the age of a bone spavin or other lesion in the living animal. Approximate estimates of the duration of roaring or whistling and many other unsoundnesses are equally uncertain, and, all things considered, the safest course for the horse buyer is to have the animal examined prior to purchase, as is the custom in Ireland, by a reliable veterinary surgeon and abide by his advice regarding its soundness. In practice and irrespective of the terms of sale, the vendor, if a horse-dealer of good repute, may offer no objection to taking the horse back and refunding the purchase money. This happens sometimes when the vendor believes that the alleged unsoundness is of a temporary character, of small importance, or questionable. Frequently the vendor disputes the existence of the unsoundness and suggests a further examination of the horse by a different veterinary surgeon, a course which, if adopted, is seldom satisfactory because it postpones decision and often leads to litigation. Occasionally a compromise is effected, the vendor exchanging the horse for another, though generally the price of the second horse is much higher than that paid for the first. In some instances the defect complained of by the buyer of the horse is only a technical unsoundness and the only thing needful to restore equanimity to both buyer and seller is a special warranty covering the defect for a period of two or three months.

A horse bought under the hammer at a repository, if found unsound, incapable, or not answering its description in the catalogue, as defined by the conditions of sale, must be returned within a specified time and accompanied by a veterinary certificate stating the cause for returning the animal. It is then examined on behalf of the vendor by a veterinary surgeon, and if his opinion disagree with that of the buyer's veterinary surgeon, the auctioneer appoints as referee a third veterinary surgeon to examine the horse, and his decision is final.

At the various horse repositories of Great Britain the conditions of sale are very similar, and the following particulars taken by permission from Tattersall's Catalogue (April 1918) may be useful to horse buyers :

Horses described as—

GOOD HUNTERS must be sound in wind and eyes, quiet to ride, have been hunted, and be capable of being hunted.

GOOD HACKS must be sound in wind and eyes, quiet to ride, and not lame.

GOOD CHARGERS or GOOD SCHOOL HORSES must be quiet to ride, quiet with troops, sound in wind and eyes, and not lame.

GOOD BROUGHAM or BUGGY HORSES, GOOD WHEELERS, LEADERS, or HARNESS HORSES, must be sound in wind and eyes, quiet in the harness specified, and not lame.

GOOD POLO PONIES must be sound in wind and eyes, quiet to ride, go to a ball, and be capable of being played in a Game.

Hunters, Hacks, Chargers, Polo Ponies, Harness Horses, Brougham and Buggy Horses, Wheelers or Leaders, without the word "Good" are not warranted beyond that the animals so described have been so used.

Horses sold with a warranty that they are quiet to ride or drive must also be workably sound, and not have any infirmity or disease that renders them incapable of reasonable work.

Horses cannot be described as "regularly" or "constantly" driven in harness unless also warranted quiet in harness.

Horses described with "good action" must not be lame.

Horses described as Good Fencers or Jumpers are not warranted unless the Horses are sold as GOOD HUNTERS, and then only that they will jump when with Hounds.

Horses are not described in the Catalogue as warranted "sound."

Horses that have been unnerved or tubed must not be sold with any description that carries a warranty.

The Causes of Unsoundness are : Defects of (1) the eyes or sight ; (2) respiration or wind ; (3) limbs or action ; (4) existing disease, effects of disease, accident, or operation ; (5) blemishes ; (6) vices ; and, very rarely (7) bad conformation.

Order of the Examination.—Orderly procedure in examining the horse is desirable. Any order may be followed so long as it enables the examiner to make a completely satisfactory examination. This is most important in connection with the limbs and feet, and unless some method is habitually practised or closely adhered to by the examiner several defects are almost certain to be overlooked. The mode of examination adopted by some examiners who pass promiscuously from one part of the horse to another should be strongly deprecated as suggesting nervousness, inexperience, or incompetence. It is not necessary to give particulars of the examiner's movements in carrying out the manual examination, but the following index, in convenient order, of the parts which must be viewed or palpated may be useful :

After inspecting the horse, the veterinary surgeon should examine its eyes, age, mouth, tongue, molar teeth, nostril, submaxillary space, parotid gland, poll, throat, larynx, trachea, jugular vein ; then withers, collar seat, shoulder point, arm, front of forearm, knee, cannon, fetlock, pastern and coronet ; next, the elbow, back of forearm, knee, flexor tendons, suspensory, sesamoid region, pastern and foot, which should be raised and the knee fully flexed. Then the chest, back, loins and croup, crural region, stifle, front of leg, hock, shank, fetlock, pastern and coronet ; next, the quarter, buttock, thigh, back of leg, point and sides of hock, flexor tendons, suspensory, fetlock, heels and hind foot, which should be raised, the hock flexed and the limb abducted. Then, passing to the head, repeat the examination on the right side of the horse. Next, raise the tail, inspect the anus, vulva, perinæum and dock. While the fore and hind limbs are being examined the inner side of the opposite limb should be carefully inspected, paying special attention to the groin, sheath or scrotum, and, in the mare, the udder. Then have the horse trotted, or walked and trotted, the fore feet searched for corns, and, if necessary, the shoes removed for further examination of the feet. Next, test the horse's wind; allow the horse to rest for half an hour; then have it brought out, trotted, and turned round on its own length. Aged horses should be tested for loss of sensation and carefully examined for evidence of neurectomy in the fore and hind limbs. On either side, above or below the fetlock, a scar or a subcutaneous nodule may be found. If median neurectomy has been performed, besides loss of sensation on the inner side of the limb, a depression, rarely a nodular swelling, will be found in the fascia inside the elbow. Apart from loss of sensation, ulnar neurectomy may leave no trace.

Inspection of the Horse.—When practicable, first see the horse in the stable. Note its attitude, especially the position of its feet. It should stand square upon all four feet. Standing with one fore foot in advance of the other is suggestive of foot lameness. If, however, the diagonal hind foot be also rested the position may be only one of ease. In horses under five years old, pointing a fore foot is not often a serious symptom. Next move the horse over in the stall and notice the movement of its tail and hind limbs for signs of stringhalt, shivering and partial paralysis. Then have it led out, observing how it turns in the stall or how it behaves if backed out. When a horse is brought out of a stable for the purpose of being examined for soundness it should not have on a winker-bridle; it should wear an open bridle, or a halter. It should be led out quietly and allowed to stand for a few minutes while the examiner makes a rapid survey of its head, neck, body, limbs, and feet, glancing at these parts from in front, behind, and both sides of the horse. In this preliminary inspection the colour and marks of the horse should be taken, the state of its breathing observed, and any conspicuous defects noted for further examination. While slowly walking round the horse, the examiner may notice one or several of the following defects: nasal discharge, grandular swelling, deformity of the face, lips or nostrils, corneal opacity, scars, galls, skin eruption, muscle atrophy, capped elbow, bumped, bent or chipped knees, bursal distensions, prominent splints, marks of speedy cutting, mallenders, or sallenders, bowed or thickened tendons, deformity of the haunch, buttock, hip or stifle, capped hocks, curb, bog spavin, thoroughpin, large bone spavin, worn or enlarged fetlocks, knuckling, windgalls, marks of brushing, ringbones, odd feet, sandcrack, ribbed hoofs, flat feet, etc.

A sound horse standing "at attention" has each fore and hind limb opposite to its neighbour and the body weight equally distributed through each limb. Standing "at ease" it may flex a fetlock, a knee or a hock—usually a fore and hind are simultaneously rested—not the legs on the same side, but the diagonal or cross legs. Trembling and knuckling of fore limbs are noticeable in horses that are unsound in both fore feet. They are usually an accompaniment of bent knees and straight or upright fetlocks and pasterns. These conditions are referred to by horsemen as "showing wear." It is a cautious and correct description, because seen in horses which have done much work and which may trot out showing no definite lameness. They ought to be accepted as defects indicating changes in the limbs which are certain to get worse and almost certain to be serious. A horse that has done no work should be sound in its limbs. A six-year-old horse with clean legs and free from blemish may be suspected to have some grave fault. It has done little work and is either a slug or has some special vice that prevents its working. The only other explanation is that it has had an owner who did not require much service.

Proceeding with the examination of the horse and observing a certain method, the veterinary surgeon should endeavour to concentrate his attention on the work in hand, using his eyes constantly and not diverting them to extraneous things. With a little practice he will overlook nothing of importance that is discoverable by sight or touch. Lameness he will notice without effort and assuming that his hearing is good he will not readily err in his opinion of the horse's wind.

Skin affections like ringworm, acne pustules, galls, mange, sporotrichosis, and other forms of eruption including grease, cracked heels, gummy heels, and mallenders and sallenders, are often met with in horses submitted to examination for soundness. Many skin diseases are temporary and of minor importance except when the eruption is extensive or so situated that it is likely to be rubbed by the saddle or harness. Here the examiner must decide whether or not the lesion is sufficient to unfit the horse for immediate work. Grease when recent may be curable, but chronic grease is likely to persist in spite of treatment. Cracked heels, even when slight and unaccompanied by lameness, may prove very troublesome. Gummy heels may be due to leg-mange or careless stable-management, or, like grease, this condition may be constitutional and chronic, causing permanent thickening of the subcutaneous connective tissue and the skin. Mallenders and sallenders are not easily removed, and though they seldom hinder the horse working, sometimes they are responsible for lameness.

Nasal catarrh, slight or profuse, fœtid or odourless, accompanied or not by cough, submaxillary swelling, or high temperature, is contagious and, although its immediate effects may be unimportant or transient, leaving no trace, the horse for the time being is unsound and it should not be introduced into a stable of healthy horses. Sometimes owing to the horse's condition (temperature, debility, or general dullness), examination cannot be safely carried further, and it is seldom wise to subject a horse with nasal discharge to the test for wind. Frequently the sequel to nasal catarrh is roaring or whistling, and the intending purchaser should be informed of the probable risk in buying the horse. Acute cough is usually associated with local or systemic disease and a fever temperature, and a coughing horse should not be purchased until the defect has disappeared. Chronic cough in most instances is a serious unsoundness because of its permanency. Paralysis of the lips or nose, cyst of the nostril wing, bulging or deformity of the bones of the face, indurated submaxillary glands, abscess formation, buccal fistula opening at the border of the lower jaw, temporal sinus with an opening at the base of the ear, and enlarged or indurated parotid gland connected with strangles infection, may be mentioned as occasional defects. The mouth may be offensive, suggesting quidding, irregular or diseased molar teeth. One or more molars may be missing, and in old horses large intermolar spaces may exist, interfering with mastication and keeping the horse in poor condition. A portion of the tongue may be awanting, the incisors worn by cribbing, or the upper jaw may be overshot (parrot mouth) hindering manger feeding and, when excessive, preventing the horse grazing. Marked constriction of the throat may be due to the horse wearing a strap to prevent wind-sucking. Enlarged or pendulous thyroid gland is often seen in well-bred horses, and though very seldom of much importance it should not be passed in silence, as the prominent gland may lead to future questioning regarding its significance. Atrophy of the laryngeal muscles due to recurrent paralysis and adhesions or indurations arising from operation on the larynx may be discovered by palpation. The trachea may be found fractured, or a breach may exist in its anterior wall, indicating recent tracheotomy and suggesting care in testing the horse's wind. The jugular on either side may be impervious or awanting, or on raising the vein a small dilatation resulting from venesection may be seen. The poll may show scars or deformity arising from injury or operation. The bursa may be distended and painless or tense from recent injury. The breast may be enlarged or œdematous, and any obvious defect of this region should be carefully examined, as disease of the sternum is often chronic and difficult to cure. A depression or prominence over a rib may indicate fracture, which in the absence of a wound is not often harmful. Girth galls should be mentioned, as they often prove intractable to treatment unless the horse is rested from work. The horse's pulse should be taken, sometimes more than once, and if found irregular or intermittent the heart should be auscultated. Any discoverable disease of the heart or lungs is a serious defect, often incapacitating the horse for fast work. In any horse which after exercise exhibits a jugular wave or regurgitation the heart should be examined. It is unnecessary to distinguish organic from functional cardiac disease, as palpitation or any form of heart affection is an unsoundness.

Hernia, umbilical, ventral, or scrotal, must be examined and carefully considered as regards its danger to the horse. A small ventral hernia may be quite harmless and, in the gelding, scrotal hernia may exist for many years without alteration or causing inconvenience, but it is an uncertain defect which at any time may lead to a fatal result. Hydrocele or dropsy of the vaginal tunic of the testicle may become a serious condition owing to bruising or infection. Scirrhous cord, tumours or warts of the sheath, scrotum, or groin, or of the thigh, may justify rejection of the horse. Warts, owing to friction, ulceration, and bleeding, may unfit the horse for work. Scirrhous growth on the cord is more likely to increase or extend than diminish and, as generally an operation is required to remove the tumour, the intending purchaser should be informed of the nature of the defect. The udder is singularly free of disease other than warts and occasionally botryomycosis and strangles infection. The perineal or anal region may show tumours or warts, the opening of a pelvic sinus or a rectal fistula, and in the mare a passage resulting from rupture may lead from the rectum into the vagina. The tail may be very limp or paralysed, or if recently docked the wound may be unhealed, the bone exposed and undergoing necrosis. The possibility of tetanus following docking should not be forgotten. Sometimes the stump is enlarged and ulcerated from botryomycosis. Disease or an unhealed docking wound of the tail renders the horse unsound.

Anchylosis of the spine, usually of the lumbar vertebræ, may be mentioned as a defect which sometimes prevents the horse lying down and interferes with his movements in backing a load. Fistulous withers or scars resulting from its surgical treatment may be seen now and then. The primary wound after cicatrization may break out anew, and therefore any disfigurement of the withers should be closely examined. A sitfast, trivial in appearance, may prevent the horse working for many weeks.

Horses submitted for examination as to soundness very seldom show defects of the shoulder or arm. Scars, collar galls, skin eruption, and atrophy of the muscles are only seen occasionally. The elbow may be capped and more or less unsightly, but apart from the probable consequences of further bruising, capped elbow is not a serious though usually a permanent defect. The forearm in hunters may show small round or oblong swellings due to punctured wounds, concealed thorns, etc., and near the knee chronic bursal distensions, but as long as they are painless and the action of the limb is satisfactory they are not of much importance.

The front of the knee may be capped or swollen, marked by a scar, or more than one, partly concealed by the hair, and sometimes the knee is stiff or incapable of complete flexion. Capped knee is more unsightly than harmful, though sometimes the result is slight stiffness of the joint owing to induration of the swelling. The popular objection to blemished knee is well known, but the risk of the horse again falling and repeating the injury is often greatly exaggerated. The scar detracts from the market value of the horse, because the possibility of further damage cannot be disregarded, but all things considered the blemish is a doubtful unsoundness. If there is no stiffness of the joint and the limb elsewhere is clean, true in action and not shaky, chipped knee only amounts to a trivial defect. A horse that has fallen once may never fall again, and if all the circumstances which attended the first fall or accident were known there would be less ground for objecting to a slightly blemished knee.

Speedy-cutting is more dangerous, and especially when the habit is associated with inward dishing or drumstick movement of the striking foot. A horse of high action in speedy-cutting may fall suddenly as if shot, throwing his rider, or if in harness, breaking a shaft and damaging himself. The chronic enlargement resulting from speedy-cut on the inner aspect of the knee varies in position ; most frequently it is formed at the lower limit of the knee or at the head of the cannon, sometimes it is seen at the mid-point between the upper and lower margins of the joint, and in high-stepping horses it may be found at the lower end of the forearm. In the first-named position the prominence resulting from speedy-cut is not easily distinguished from exostosis or knee splint, which again may be confused with knee spavin. As a rule, speedy-cut does not involve the joint, while knee splint or knee spavin is very similar to spavin disease of the hock. Care, however, is required in naming these defects and estimating their importance. Locally, speedy-cut is the least harmful, while knee splint or spavin may give rise to lameness which can only be removed by resorting to neurectomy.

The region of the cannon is examined mainly for splints and defects of the tendons and suspensory ligament. Large splints can be seen, but small or pea splints are difficult to discover, often requiring repeated careful palpation of the bones for their detection. Though splints are most frequently found on the inner aspect of the cannon, they also occur on the outer side and occasionally at the back of the bone under the suspensory ligament. Splints usually appear on the upper third of the bone ; some, close to the knee, may involve the joint formed by the lower row of carpal bones with the metacarpus ; while others, less common except in cart horses, affect the lower third of the cannon at the " button " of the splint bone. The old saying, " the higher the splint the greater the danger," contains a fairly true warning regarding the position of splints. Excepting Arabs and thoroughbreds, which often escape, horses of every class, light and heavy, large and small, may be the subjects of splint disease, which is most common in horses under five years old, though aged horses are not altogether exempt.

Splints derive their importance from the lameness which they produce and which is caused during their formation. Small splints, which are often multiple, and in consequence accompanied by more extensive inflammation, are frequently more troublesome than large, single splints. An exostosis formed entirely on the large metacarpal bone may attain conspicuous size without at any time inducing lameness. Some large splints are so situated that they interfere with a flexor tendon or the suspensory ligament, the prominence of the splint exerting pressure during movement on the tendon sheath. Occasionally a growth of adventitious fibrous tissue in the vicinity of the splint appears to increase the thickness of the adjacent tendon aponeurosis, giving on palpation the impression of a slight sprain. A young horse may be affected with splint lameness of one or both fore limbs—sometimes alternate limbs—at short intervals for a year or longer and eventually recover and remain sound in action. Here, recurrence of lameness should not be attributed to a relapse or to further change in a pre-existing splint, but to the formation of a new one or a sequence of splints. Old or fully-formed splints in horses over six years old are of little consequence except in those few cases in which the bulge of the splint is in contact with a tendon, but always the existence of splint should be mentioned in the certificate, as it constitutes a technical unsoundness. When very prominent, splints may be injured by striking, though lameness from this cause rapidly disappears under simple treatment. It is wrong to suppose that a splint which has existed a year or two may suddenly resume its original state of activity and painfulness, but the rare possibility of a new splint forming on the cannon of an aged horse must be admitted, though the exciting cause may remain undetermined.

Splint lameness affecting a hind limb is not common, and in most instances the splint is on the outer side of the upper fourth of the shank. In horses standing between bails and in others addicted to kicking, the splint may be the result of a blow, but now and then an aged horse is lame from the formation of one or several small splints on a hind shank which is quite free of any indication of wound or bruise.

Few horses with acute limited strain or extensive old-standing strain of the flexor tendons are submitted for examination as to soundness. They are too lame to have any chance of being passed except for slow work. Sometimes a horse with chronic flexor strain is subjected to median neurectomy in the hope that the lameness will be removed and the thickening of the tendons attributed to rheumatism. Median neurectomy diminishes or removes the nodding of the lameness, but it does not enable the horse to step out freely in the trot, and often the knee is much bent owing to fibrous adhesions in the vicinity of the strained part of the tendon. Sometimes a saddle horse which has made a qualified recovery from slight strain of a flexor tendon or the suspensory ligament is presented for examination. The position as well as the extent of the lesion should be ascertained by careful palpation of the tendons and ligament, and in any case of slight strain it is advisable to postpone judgment until after the horse has been tested for wind and rested for an hour in the stable. If, on re-examination, the strained part is found painful and more swollen and accompanied by lameness which cannot otherwise be accounted for, it is unlikely that the horse will stand work without aggravation of the defect. If, however, the suspected strain remains unaltered and there is no lameness the horse may prove a useful purchase even for fast work. Strain of the perforatus at the fetlock or below it, or strain of the perforans or its check ligament at any point, is always serious because it is almost certain to lead to persistent lameness. Strain or "bowed sinew" of the perforatus midway between the knee and fetlock, or strain of the body or a branch of the suspensory ligament, seldom causes more than temporary lameness. In either case, after proper treatment of the lesion and reasonable rest the horse will become quite serviceable in harness or saddle in spite of evident thickening of the tendon or ligament. Chronic tendo-vaginitis of the flexors at the fetlock of a hind, or, less frequently, of a fore limb, causing, at first, the horse to go on the toe and later to trot lame, should not be overlooked. Œdema, puffiness, or diffused, slightly painful swelling over the flexors without lameness or appreciable localized thickening of either tendon or the suspensory, when not symptomatic of constitutional disease or a lesion of the foot or pastern, is usually the forerunner of chronic distension of the flexor sheath. If neglected, sooner or later it induces slight lameness and progressive tenositis. In old and, less often, young horses which have done much fast or slow work, the flexor sheaths may be found thickened throughout; lameness may be absent or very slight, and usually the defect does not interfere with the horse's fitness for work. The foregoing remarks on tendons refer mainly to the fore limbs. Slightly modified they may be applied to the hind limbs, in which flexor strain, though less frequent, is not less important than that of the fore extremity.

Any degree of flexor or suspensory strain is an unsoundness. In most instances the defect is more likely to grow worse than better. A horse with slight flexor strain may be considered serviceable or suitable for the purpose required, but he should not be described as sound.

Knuckling at the fetlock may be symptomatic of tendon strain or other lesion below or above the joint. Symptomatic knuckling of a fore or hind fetlock is easily understood, but slight knuckling of a fore fetlock from no apparent cause may be difficult to explain. It may be the result of accident in foalhood, partial dislocation or wrenching of the joint, or the faulty position may have been acquired in early life through some temporary defect of the foot, and when overshot fetlock is associated with upright pastern it is unlikely to disappear, though very seldom does it cause immediate lameness. Knuckling of both hind fetlocks in young horses is often temporary. Raw, young horses on their introduction to town work frequently show this knuckling for a time or until they overcome the tendency to brushing and slipping on the various pavings of the streets. Weakness or lack of condition may account for some of these cases, but in many instances they arise from fatigue due to awkwardness or want of confidence in horses unaccustomed to the insecure foothold of the streets. Knuckling without evident causal lesion should be mentioned to the buyer of the horse, because subsequent local injury may add to the permanency of the defect.

Windgalls may be connected with the flexor synovial sheath or with the joint of the fetlock. They vary in prominence, and also in their effects, which for a long time may be nil. Windgalls indicate either fetlock weakness, which may be hereditary, or effects of wear. They seldom cause lameness except when injured, or when the distension is large enough to hinder movement of the joint. Tendinous windgall is more likely than the articular form to cause trouble, but neither should be present in a sound horse. Tendinous windgall of a hind fetlock may lead to persistent knuckling and permanent lameness owing to chronic bursitis, thickening of the synovial sheath, and formation of fibrous adhesions which fix the tendons at the sesamoids.

Distension of the bursa of the extensor pedis tendon of a fore or hind fetlock is always the result of injury, which may be contracted in jumping a fence or wall, in knuckling when starting a load, or in falling on the fetlocks, as happens in cart horses which sleep standing. The distension or bursitis may or may not be accompanied by lameness, which in hunters may be only manifested after a rest following work or prolonged exercise. In cart horses both fore fetlocks may show abrasions and swelling, or one or both hind fetlocks may be disfigured by a large, more or less pendulous distension which looks like a tumour. The existence of bruised fetlocks or distension of the bursa of the extensor pedis tendon in the horse should at once suggest other defects, as anchylosed spine, not lying down, falling when sleeping standing, etc.

Enlargement of one or both sesamoid bones points to antecedent, sometimes remote injury to the fetlock. If the horse is not lame and the fetlock is free of other defects, the enlargement, though amounting to a technical unsoundness, may be regarded as of very small importance.

Cutting and brushing marks on the fetlocks should be mentioned and carefully considered as to their causation and probable duration. In young horses striking may be and often is a transient fault, but in aged horses, when not due to bad shoeing, weakness, or fatigue, it may be very troublesome and sometimes incurable. When the conformation or carriage of the limbs is faulty, predisposing to striking, cutting or brushing is likely to result in persistent recurrent lameness. The examiner of the horse must decide whether or not the abrasion on the fetlock is old or recent or likely to be repeated, and advise accordingly. Old brushing scars may be mentioned with the marks of identification of the horse.

Ringbone disease, though not common, is a very serious unsoundness. It is very similar in nature, progress, and effects to spavin disease of the horse's hock. According to the case it affects the short pastern, either extremity of the long pastern, or the coffin bone, and sooner or later implicates the adjoining articulation, producing arthritis, enlargement of the bones, and more or less deformity of the pastern or foot. Very few horses affected with ringbone disease are sound in action. This simplifies procedure in examinations for soundness, as the cause of lameness need not be specified. The term ringbone is often applied to simple exostosis of the pastern, node, or "ankle bone," which in practice should be distinguished from ringbone disease. Exostosis of the pastern exists in the majority of heavy horses and in many of the lighter breeds. It should not be overlooked, for it cannot be regarded as an advantage to any horse, but compared with ringbone disease it is a harmless defect. It is often situated laterally close to the attachments of the ligaments on the long and short pastern bones. As a rule it does not at any time cause noticeable lameness.

Enlargement of a pastern bone resulting from simple fracture or "split pastern" may be confused with ringbone in stallions and mares which are submitted to examination for hereditary diseases. Split pastern is usually confined to one limb and the resulting enlargement is smoother, more diffused, and more likely to diminish than that of ringbone disease, in which it is most prominent at the articular margins of the affected bones. In many instances the distinction is not clear, and in the absence of a reliable history of fracture the suspected pastern should be very carefully examined.

Sidebone may affect one side or both sides of one or both fore feet and rarely the hind feet. It is common in heavy draught horses, less common in lighter draught animals, and only occasional in ponies and well-bred saddle and harness horses. The process of ossification may begin at any age and its extension may be gradual, fairly rapid, or very slow. Injuries as a blow or tread on the coronet and disease of the foot (sand-crack, suppurating corn) are sometimes responsible for the change in a single cartilage—often that on the outer side of the foot, but as a rule double-sided sidebone is connected with hereditary predisposition to the disease, and constant hard work on paved roadways promotes the transformation of the cartilage into bone. Sidebone uncomplicated by other disease of the foot or pastern seldom or never causes lameness in draught horses, and in light horses doing fast work its worst effect is cramped action. Sidebone, incipient, partial, or complete, is an unsoundness, but so long as the feet are of good shape it is not a serious defect. Complete sidebone gives no difficulty in diagnosis, but the existence in certain cases of partial or incipient sidebone may be disputed. Partial sidebone represents a stage in the process by which the lateral cartilage will be ossified, and the mere fact that the change is limited or incomplete does not abate the importance of sidebone as a hereditary unsoundness. A sound lateral cartilage should be resilient and pliant throughout, but as nearly one half of each cartilage lies within the hoof in normal feet, only the part above the horn can be palpated or tested for rigidity or ossification. Further, as the change in the cartilage usually begins inferiorly or where the concealed portion is attached to the pedal bone, ossification may have made considerable progress upwards and forwards before hardening or other alteration suggestive of sidebone can be detected in the part above the hoof. This fact should not be forgotten in cases of partial sidebone in which the ossified area generally occupies the centre of the plate. The hinder or slightly incurved portion of the cartilage is only ossified in complete sidebone, and in other cases the anterior part may not be ossified though frequently it fails to yield to pressure, because it rests against a prominence of the coronary bone. A lateral cartilage may be hard yet flexible, and although this condition cannot be regarded as typical of sidebone, it indicates that ossification is proceeding and that eventually sidebone will be formed. In some cases sidebone formation is preceded by perichondritis, which extends rapidly over the cartilage, making it thicker and less flexible. This change is followed by ossification throughout of a small area of the cartilage, which, by gradual extension of the process, becomes completely transformed into bone.

The Feet.—Faulty conformation of the foot may be natural or congenital, and it does not amount to unsoundness unless it is evident that the defect will interfere with the horse's usefulness. The feet should be carefully examined as to shape, condition of horn, and indications of disease. The old and often-quoted dictum of Jeremiah Bridges, "No foot—no horse," is as true to-day as at any former time. The fore-feet may be unequal in size, one being contracted or notably smaller than the other, or both may be blocky with deep, narrow heels. Either condition is suggestive of serious foot trouble, though often odd fore feet and blocky feet are natural and not symptomatic of navicular or other disease of the foot. Such feet should be closely inspected, and judgment should be guided by consideration of the horse's action in the trot and his age. If the horse is over six years old, lame in front, and his action improves with exercise, very probably the seat of lameness is in the foot or feet, according to the case. In the absence of lameness or varying action the existence of blocky feet or odd fore feet should be stated by the examiner in his report on the soundness of the horse. Corns often occur in blocky feet and are very difficult to cure, because chronic ostitis of the plantar aspect of the pedal bone is a frequent complication. Flat-foot is often congenital, though it may be acquired. The sole is almost level with the margin of the wall, the heels are low, wide, often spreading, and the wall is extremely oblique. As the sole is usually thin it is easily bruised and lameness from corns is common. If laminitis attack flat-feet the result may unfit the horse for further town work. The wall is weak, often brittle, and the shoe is frequently loose or cast off. Very few horses with flat-feet can long withstand the effects of journeys or constant work on paved streets, but for short runs or light, pleasure purposes they may prove useful, though generally they require special care in shoeing.

Sand-crack of the toe or quarter, whether causing lameness or not, is an unsoundness. According to the length and depth of the fissure and the treatment applied many months may elapse before the sand-crack grows out with the descent of a new intact wall. Superficial and partial sand-cracks are of less importance than deep and complete sand-cracks. Open sand-crack accompanied by lameness is a very serious condition. Superficial sand-cracks may cause no inconvenience to the horse so long as care is exercised in shoeing and keeping the hoofs in good condition. Cracks in the hoof near the ground border of the wall are not recognized as sand-cracks, which always begin at the coronet and are carried downwards with the growing wall. Fractures or cracks of the wall near the shoe may be due to careless shoeing or brittle hoof, which is easily fractured.

False quarter is a permanent defect of the wall, a portion of the horn being awanting owing to limited destruction of the coronary band which secretes the greater part of the wall of the hoof. The defect or scar in the coronary band may be obscure or easily seen, and the breach in the wall or false quarter is usually conspicuous, as a depression with irregular margins which sometimes overlap. False quarter is incurable, though frequently it does not appear to interfere with the horse's action or usefulness. It is an unsoundness.

Seedy-toe may affect the fore or hind feet. The separation may be limited to a small area of the toe wall, or it may extend upwards to near the coronet and laterally towards the quarters. Commencing seedy-toe may be overlooked, as it rarely causes lameness or immediate deformity of the foot. Old-standing or extensive seedy-toe is accompanied by more or less, sometimes characteristic, lameness and deformity of the wall and sole. In the absence of deformity seedy-toe may be suspected, and confirmation may be obtained by percussion of the wall, but in most horses submitted to examination for soundness this defect can only be discovered with certainty by removing the shoe and searching the foot. The separation is progressive, occasionally intractable, and when extensive a year may be required to restore the hoof to a sound condition.

Convex toe wall, that is a prominence or ridge extending from the coronet to the plantar border of one or both fore or hind feet, is symptomatic of low ringbone or pyramidal disease. The horse's gait—going on the heel—may suggest chronic laminitis as the cause of the peculiar action. Ribs or rings arranged horizontally in the wall of the hoof may be due to a change in diet, as a run on pasture, or to indigestion, or laminitis. Dietetic rings are equally spaced and preserve their independence throughout, while those arising from disease are disposed irregularly, perhaps broken, in their course from one quarter to the other, and when connected with chronic laminitis they converge at the depression of the toe wall. Sinking of the toe wall indicates displacement of the pedal bone, with flat or convex sole, and in trotting the horse brings the heel first to the ground.

Club-foot, crooked or distorted hoof, and in-turned and out-turned toe are congenital defects in most instances. A hind foot may appear clubbed after healed fracture of the pedal bone. This condition is known as " buttress foot," and in consequence of the deformity of the pastern the horse goes on the toe of the affected foot. An inturned toe is preferable to an out-turned one unless the faulty foot in movement threatens to strike the opposite limb. Out-turned toe predisposes to quarter sand-crack and to cutting or brushing.

Horn tumour under the wall is a rare cause of unsoundness. No doubt there is a stage in its growth when there is no lameness, but sometimes in searching the foot for suspected seedy-toe a crescentic area of tough horn which indicates horn tumour may be found at the white line. As a rule, horn tumour is accompanied by lameness, but owing to the horse " pointing " the lame foot the defect in action may be mistakenly attributed to navicular disease, in which lameness wears off with exercise, while that due to horn tumour continues unaltered or somewhat aggravated. Thrush, or catarrh of the glands of the sensitive frog, is often a chronic ailment which may become serious if neglected. Thrush is more common in the hind than the fore feet. The co-existence of thrush in a fore foot with slight lameness in a worn or aged horse is suggestive of navicular disease. Thrush is an unsoundness. In cart horses it may foreshadow canker of the foot, and in all classes it may lead to extensive destruction of the horny frog. In the majority of cases thrush is a trivial and temporary defect, amenable to curative treatment, but its existence should not be overlooked. Navicular disease, when incipient, in a well-preserved horse may mislead the examiner who believes in the invariable manifestation of the so-called " classical symptoms " of this malady. In some horses the foot or feet may be well-formed or of excellent shape, pointing may be absent, and varying action under exercise may not be observable in the early stage of navicular disease. Advanced cases are easily recognized by attending to the horse's action throughout the examination.

Chronic laminitis attracts attention because of the horse's gait, which, though characteristic of this affection, is not peculiar to it. Going on the heels with more or less tilting of the toe is shown in low ringbone, horn tumour, toe sand-crack, painful condition of the extensor region of the coronet and pastern, etc., but generally in chronic laminitis there is deformity of the hoof. Corns, whether dry or moist, recent or of doubtful duration, constitute unsoundness. Their importance bears some relation to the shape of the foot. In flat, thin-heeled feet, and in blocky feet with deep heels, bruising is frequent and the effects are likely to persist for a considerable time, because of co-existing ostitis of the pedal bone, which in chronic corns is often studded with asperities on its ground surface.

Hind Limbs.—In horses submitted for examination a common defect is fractured external angle of the haunch. The quarters are unequal in prominence, as may be noticed when the horse is viewed from behind. The deformity may be accompanied by lameness if the accident is recent, but in old-standing cases lameness should be absent and the defect should have no influence on the horse's capacity for work. A similar condition affecting the buttock may be met with. The tuber ischii may be fractured and displaced, diminishing the prominence of the buttock. A horse with either defect cannot be considered as sound, but he may with confidence be described as serviceably sound. After recovery from either injury he is likely to continue as sound in action as he was before the accident. Muscular atrophy of the hip is sometimes seen, and, possibly, may be due to inaction of the limb arising from bruising or chronic lameness of the hock, fetlock, or foot. Gluteal atrophy may have a local origin (paralysis, pelvic fracture), but in the absence of lameness and evident deformity the defect can only be referred to as symptomatic of antecedent inaction of the limb.

The stifle is very rarely found unsound in horses submitted to examination, probably because very simple injuries to this region produce noticeable lameness. Abrasions, capped stifle, and obliteration of the surface indentation below the patella may be seen occasionally, and as the prognosis of any form of stifle lameness is uncertain, the defect, though apparently slight, must be regarded for the time being as an unsoundness. The lower thigh or leg is very seldom the seat of unsoundness. Indurated swelling resulting from injury, tumours, and warts may be met with on either surface of the leg. The inner prominence (internal malleolus) of the lower extremity of the tibia may be conspicuously enlarged, and this may be mistaken for spavin. It is a harmless defect, and when not congenital its origin is due to a blow. Occasionally large tendinous thoroughpin of the hock extends upwards, disfiguring the inner aspect of the leg.

The hock furnishes the most serious and frequent unsoundnesses of the hind limb. Curb may be confused with sickle hock or with curby formation of the limb, a congenital condition in which the os calcis, instead of being vertical or upright, slopes forwards, and the posterior line of the limb from the lower thigh to the pastern appears more or less regularly curved when the limb is viewed from the side. Curby formation of limb, though unsightly, may not impair the horse's usefulness. Some think that it predisposes to the formation of curb—which is the result of strain of ligament or tendon at the back of the hock. Large or very conspicuous curb in a saddle-horse is a serious unsoundness. Lameness may be absent at the time of examination, but it is likely to recur when the horse is put to regular work. In harness horses, large curb is of less consequence, though buyers of affected animals would be well advised to anticipate contingencies and secure a special warranty covering the defective hock for three months or longer from the date of purchase. Small curb unassociated with lameness may be of little importance, but the distinction sometimes made in practice between "false curb," or enlarged head of the small external metatarsal bone, and "true curb," or strain of the calcaneo-cuboid ligament or perforatus tendon, is not often based on accurate knowledge of the nature of the prominence or curb. A portion of the ligament is inserted on the head of the external splint bone, a fact which is often ignored, and in many instances of so-called "false curb" palpation does not enable the examiner positively to state that the prominence is solely due to enlargement of the head of the small bone. Frequently it is only partly due to that cause and partly to thickening of the ligament. Curb, whether very limited or diffused, true or false, should always be mentioned in the certificate, and in most instances a fair estimate of the importance of the defect should be offered to the intending purchaser of the horse.

Bone spavin unaccompanied by lameness is a much-overrated unsoundness. Spavin may gradually form and attain conspicuous size without causing noticeable lameness, and after formation of the exostosis is complete, or the process has become arrested and the affected bones anchylosed peripherally or centrally, the horse is likely to continue to give satisfaction for many years in saddle or harness. A plainly spavined hock free of lameness may withstand the effects of severe work much longer than a hock having no trace of spavin. Compared with large or diffused curb, spavin is altogether a less risky defect, and in some horses the exostosis would seem to add to the strength of the hock. This hopeful view is to some extent discounted by the fact that spavin lameness may be incurable, and this applies particularly to the occult form of the disease, in which there is no appreciable enlargement at the usual seat of spavin. Exostosis, even when small, situated well forward or at the front of the joint, is always more dangerous than spavin formed on the postero-internal aspect of the hock.

Spavin disease may affect any hock, but it is more likely to occur in hocks which, viewed from in front, appear narrower or to taper towards the shank and less likely in square hocks—that is, those which show the same breadth at the head of the shank as at the upper or tibial margin and which at first view look like spavined hocks.

Diagnosis in the absence of lameness may be easy or difficult, depending on the prominence of the exostosis. Coarse, tuberous, and odd hocks have to be considered, and occasionally a doubtful hock may be passed without remark because its action is good. But good or faultless action alone is no proof that the hock is free of spavin. As a rule, spavin disease does not implicate the tibio-tarsal or principal joint of the tarsus, and unless the ostitis is active it has no influence on flexion or extension of the hock. In spavin lameness impaired hock action is due to the pain induced by the existing ostitis or arthritis of the affected small bones or joints, and not to the enlargement hindering movement of the hock joint. Large spavins may be recognized by viewing the hocks from in front or behind, but in all cases resort should be had to palpation. Hints as to the best procedure in diagnosis are helpful, but only practice in the palpation of sound and unsound hocks will impart confidence to the examiner. Passing the hand slowly from the tibia to the shank over the inner surface of the extended hock the normal prominences of the bones or, preferably, the spaces between them, should be identified. In spavin these spaces or some of them are effaced or concealed by the exostosis. Sometimes palpation of the flexed hock gives more reliable information of the actual state of the spavin area. The suspected hock should be compared with the other one, and when both are doubtful examination should be repeated patiently until a positive opinion can be formed. When convenient, X-ray examination of the hocks will in most cases remove doubt as to the existence of spavin.

Odd hocks, like odd fore feet, may be congenital, but the examiner is under no sort of obligation to be absolutely certain of the origin of enlarged hock or of any other unsoundness, unless there is an express stipulation to that effect. He should point out the defect and give a qualified opinion of its probable effect on the horse's usefulness, and, if necessary, suggest that the vendor should furnish a special or time warranty covering the odd hock for a reasonable period.

Coarse or tuberous hock bones are frequently seen in horses under five years old, and generally in such cases the bones forming the other joints of the limbs are equally coarse or prominent. With advancing age rough or coarse hocks lose this feature, the prominences diminishing or, as is said, "fining down." In the majority of instances coarse hocks coexisting with similar prominences on the other joints are sound and unlikely to lead to lameness.

Occult spavin disease in the active state is always accompanied by lameness, which does not diminish under exercise. The hock is seldom enlarged, though on post-mortem examination small exostoses may be found at the margins of the affected joints. Thus affected a horse may not be rejected for spavin, as there is no appreciable enlargement of the hock, but for lameness, which is continuous and usually very well marked.

Bog spavin or distension of the true hock joint may be acute or chronic. Fortunately acute bog spavin is rare, for generally it is incurable. Chronic bog spavin is common, and so long as the distension is not excessive it may not interfere with the action of the hock. Straight hocks are predisposed to bog spavin, which in most instances may be regarded as a sign of weakness or of wear. In some horses bog spavin coexists with articular thoroughpin and distension of the synovial sheath of the perforans (tendinous thoroughpin). These distensions, when small or of moderate size, appear to have little influence on the horse's action or capacity for work, slow or fast, but as they may at any time suddenly undergo considerable increase, becoming large enough to hamper hock movement, they should be mentioned as unsoundnesses.

Two other synovial distensions in this region may be mentioned; one affects the peroneus sheath on the outer side of the shank, the other the sheath of the accessory flexor on the inner side of the hock. Both are noticeable and generally harmless. Capped hock is an obvious and very common defect. Two forms are recognized: one, extremely rare, affecting the synovial bursa beneath the perforatus cap, the other the mucous or subcutaneous bursa over the tendon at the point of the hock. The first produces bilateral distension and lameness, which is not easily removed. The second or commoner form is a conspicuous blemish, which in practice is often included with the recognition marks of the horse.

The principal defects or unsoundnesses of the hind limbs below the hock have already been referred to under the examination of the fore limb. Slightly modified or amended where necessary, the remarks made on the fore cannon, flexor tendons, suspensory, fetlock, pastern, and foot may be applied to these parts of the hind limb.

Action and Lameness.—Want of care more often than want of skill causes failure to detect slight lameness. And it must be remembered that the veterinary surgeon called to prescribe for the lame horse of a client receives every assistance in his work, but when examining a horse as to soundness he may have to contend with the most astute attempts to mislead him. There are lamenesses which temporarily disappear on the horse being exercised, therefore all attempts to detect lameness should be conducted after an assured rest of not less than half an hour in a stable, and when practicable this rest should immediately follow rapid exercise as that of the test for wind. If it is certain that the horse has not been taken out of his stall there is no better time than the early morning—after a night's rest. When possible this is a desirable precaution, but often the circumstances attending the examination preclude its adoption. The veterinary surgeon may be called to the vendor's stables, or the horse may be brought to the veterinary yard, and unless there is ample time and the examiner has more than the usual modicum of tact he may be defeated in his effort to make a searching examination for lameness. However, if he will concentrate his attention on the horse throughout the examination, declining to discuss weather, health, or holidays, or to laugh too much at the vendor's good story, he will not often fail to observe lameness even when it is very slight.

The horse should be led out quietly and allowed to stand for a minute or two, then slowly trotted about thirty yards on a paved roadway, turned, and trotted back to the examiner. A slow trot is the best pace at which to discover lameness, and a loose rein permits the movement of the head—the nodding—which is most indicative. A slightly lame horse that is brought out of a stable and frightened or excited, especially if his head is held tightly, shows very little, if any, defect in movement. An experienced runner may assist in covering a slight lameness. The order to "give him his head" is often needed, but it must not be forgotten that obedience to such a command may result in the runner being seriously kicked. A paved roadway is absolutely necessary to a proper test of action or lameness. In the country a grass field or a bridle path may be most convenient for trotting the horse, but the test on either or both is insufficient and unreliable, and if lameness should be overlooked the examiner may be accused of negligence in conducting the examination. Even at some inconvenience to himself the examiner should insist upon seeing the horse trot on a hard road with a fairly even surface and a slight gradient. Lameness of any degree, however arising, is an unsoundness. A horse's action may be objectionable, as in dishing outwards or inwards, threatening to strike or cut, rolling, waddling, hitching, etc., but so long as the peculiarity arises from conformation and not from disease, accident, or other acquired cause, it is not unsound unless it is dangerous or likely to prove inconsistent with the usefulness of the animal. Occasionally a horse exhibits in front or behind a peculiar gait which may vary with the pace of movement and which at first view may puzzle the examiner. But more often than not peculiarity of gait is a mere euphemism for slight lameness, and in any supposititious case of this kind the horse should be trotted repeatedly at short intervals with and without a weight on his back and after resting from cantering exercise. In most instances this procedure will accentuate slight or doubtful lameness or remove the supposed peculiarity of action. Care must be exercised in watching a horse trotting with low or short front action. This peculiarity may be due to chronic disease of the feet, or it may be natural to the animal. Half an hour's trotting exercise will settle the point by increasing the freedom of action, whilst a further half hour on the pillar reins and another run out in hand will show the horse again at his worst. At auctions where only a run can be obtained, any doubt about the fore feet should take into consideration the age of the animal and a verdict given against horses over six years old. Whilst turning round, a horse often shows some symptom such as snatching up the foot, knuckling over, or crossing the legs, which is not so noticeable in a straight run. When a horse is set back there may be an exhibition of abnormal movement, which is not so well seen under any other circumstances. But the examiner should remember that a green horse or a bad-tempered one will sometimes object to being backed and then move erratically. Every horse does not run in hand quite evenly with a bit in his mouth. He may carry his head to one side and give an appearance of lameness in front. When a doubt exists as to the presence of "bridle lameness," a halter should be substituted for the bridle and the horse again trotted until the examiner is satisfied one way or another.

Stringhalt, whether continuous, intermittent, or occasional, must be regarded as an unsoundness, though in a working horse it may not be a serious defect. Stallions and mares affected with stringhalt are justly condemned as unsound for breeding purposes. The cause of the spasmodic action of the limb or limbs remains undetermined. Stringhalt may be manifested by an upward jerk of the foot (flexor stringhalt) or by a downward thrust, the foot forcibly striking the ground (extensor stringhalt). Occasionally both these movements are pronounced and very noticeable in the horse at work, and in some cases the shoe may be loosened or broken, and in backing the horse may injure himself.

Stringhalt may appear at any age and remain stationary or become aggravated with advancing years. Frequently it arises quite suddenly and from no appreciable cause. Occasionally it appears during or soon after a horse's recovery from a slight illness, accident, or operation like docking, or it may follow blistering or firing a leg—either fore or hind. Intermittent slight stringhalt of one or both hind limbs may exist for years without noticeable variation, or it may become continuous or much more evident. It very seldom disappears entirely, though sometimes continuous manifestation becomes intermittent, the intervals gradually extending until the defect is shown only very occasionally.

Stringhalt is often detected when the horse is moved over or turned in his stall. It is also seen in the first few steps of a slow trot and very frequently in the act of turning the horse to come back to the examiner. It may be revealed by backing the horse, or by turning him to the right or left completely round on his own length. Sometimes it is only discoverable after the horse has been severely exercised or when he is tired. In ponies with excellent hock action slight stringhalt may be confused with "straw cramp" or momentary arrest of the patella on the femoral trochlea, but in the latter, owing to the stifle being held in extension, the foot "dwells on the ground"—as if fixed—for a few seconds before it is jerked upwards. The movement of stringhalt is involuntary, while that of "straw cramp" is voluntary and due to effort imposed on the limb by the state of the stifle.

Shivering is an important unsoundness, and much more serious than stringhalt, because generally it is progressive and in time renders the horse unfit or less useful for ordinary work. Affected stallions and mares should not be used for breeding, as their progeny are almost certain to exhibit symptoms of shivering before or soon after reaching maturity. Shivering affects the upper or gluteal and femoral regions of one or both hind limbs and the tail, sometimes a fore limb, and occasionally the lips and muscles of the head and neck. The characteristic tremor and elevation of the limb are due to involuntary spasmodic muscular contraction. Shivering is most common in cart horses. It also affects light harness horses, hunters, hacks, thoroughbreds, and, rarely, ponies. It varies in intensity, and may be intermittent or continuous in manifestation. It is aggravated by constant hard work on paved streets and poor feeding, and, temporarily, by violent effort, excitement, or by intercurrent systemic or local disease or injury. Slight shivering is often modified, the symptoms being suspended by prolonged idleness, grazing the horse for a month or two, or by easy slow work on land. As the disease advances the horse, though still useful for straight pulling or trace work, becomes unwilling or unable to set back a load; he refuses to lie down, and in sleeping standing frequently half-falls, bruising his fetlocks and sometimes contracting other injuries. Hunters, at first, may gallop and jump satisfactorily; later, they lose confidence or show difficulty in rising to or clearing a jump, and eventually they soon tire in galloping, blunder at their fences, and become unsafe or useless for hunting. Confirmed shivering is easily recognized, but when the defect is slight repeated examination of the horse may be necessary before the symptoms can be discovered. Many methods of testing the horse are employed. The more useful are: backing the horse rapidly on rough setts, turning him round on his own length, moving him from side to side in a stall, raising and abducting each hind limb, smartly tapping the shank, front of the stifle, or point of the elbow while backing the horse, offering the horse water in a bucket placed on the ground, raising a hind foot and hammering the shoe or hoof, and pricking the hind fetlock or pastern. The symptoms may be revealed by resting the horse in a dark box for half-an-hour and then lifting a hind foot, or by lunging or cantering the horse for a time, followed by a rest in a stall and afterwards lifting a hind foot or moving the horse from side to side.

Partial paralysis, which usually affects the horse's hind limbs, is only likely to escape notice when the defect is very slight. Sinking of the quarters or crossing the hind limbs when turning, signs of inco-ordination of movement, or marked awkwardness in backing, striking the hind limbs when turning completely round, and rocking or waddling in the trot are all more or less suggestive of posterior paralysis.

"Jinked back" and "kidney dropping" are terms of indefinite meaning and application, though commonly employed to indicate spinal weakness. These defects and loss of power caused by arterial obstruction are discovered while the horse is undergoing the test for wind. A jinked-back horse after going some time loses power in his hind quarters and gradually sinks to the ground, sitting like a dog for a few minutes, then rising voluntarily and cantering on as at the beginning of the trial. The subject of aortic or iliac thrombosis gradually fails behind when trotting or cantering. The chief symptoms are shortening of the stride, dragging of one or both hind feet, knuckling of the hind fetlocks, drooping of the quarters, diminishing hock flexion, with dryness and palpable coldness of the limb downwards from the hock. Unable to continue, the horse moves slower and slower, then, crouching, blowing, and sweating, goes down, struggling a little as if seized with colic. After a few minutes he recovers sufficiently to rise, shakes himself, and trots on again with no sign of inability or loss of power in the hind limbs. As some forms of partial paralysis are only manifested under exercise like that required in testing the animal's wind, the examiner, when possible, should insist upon making a full examination of the horse. In some instances a limited examination may be sufficient, but when a certificate of soundness is required the examination should be thorough and complete.

Removing the horse's shoes to facilitate examination of the feet, though not imperative in every case, should not be neglected, especially when the state of the hoofs is suggestive of foot disease. Seedy-toe may exist in a fore or hind foot of irreproachable shape and appearance, and although percussion may enable the examiner to discover the defect, a positive opinion should only be given after removing the shoe and searching the foot. But the shoes should not be removed without the vendor's sanction, which is very seldom refused. Removal of shoes may be prohibited by the conditions of sale in force at auctions. If the horse is sold as sound, the prohibition is unfair to the buyer and distinctly questionable in law. A client may find fault with his veterinary surgeon for not having the horse's shoes removed at the time of examination, but the examiner is under no sort of obligation in this matter. He may or may not have the shoes removed, according to his judgment as an expert, but he cannot escape responsibility for his opinion of the horse's soundness.

Eyes.—Although horses frequently suffer from injuries or diseases—serious or trivial—of the eyeball or its appendages, it may be said that, in those submitted for examination as to soundness, defects of the eyes, other than opacities of the cornea and lens, are not often encountered. Occasionally, blindness (amaurosis) due to paralysis or to inflammatory change within the eyeball is met with. Glaucoma is extremely rare. The lachrymal apparatus is very seldom found diseased, and defects of the eyelids, as ptosis (paralysis of the upper eyelid) and deformity resulting from wounding, are far from common. Sometimes, owing to recurrent attacks of ophthalmia, the eyeball is found atrophied, the media opaque, and in rare instances one eye may be collapsed or awanting. Shying in certain cases may equal an unsoundness, though usually it is regarded as a vice. Shying may be due to astigmatism (see " Diseases of the Eye "), short sight or long sight, or it may arise from corneal opacity, cataract, or other lesion of the visual axis. It may be only coincidence, but sometimes persistent shying coexists with large corpora nigra which appear to obstruct the pupil.

Corneal opacities may be temporary or permanent, and they vary greatly in size, shape, density, and position. During an attack of specific ophthalmia the cornea may be completely opaque. Dense patch-like opacities may be seen at a considerable distance from the affected eye, but the smaller, less dense, specks, streaks, or hair-like lines may be readily overlooked unless the eye is in a favourable position or under artificial illumination at the time of examination. Sometimes there is no definite or isolated opacity, but the transparency of the cornea—all over—is impaired by dimness, which is comparable to steamed glass and recognized as " cloudy cornea." Every corneal opacity while it lasts is an unsoundness, but its importance varies with the size, position, duration, and probability of removal of the defect and with the class of horse. Small, thin, spot or streak-like opacity situated towards the corneal border is of minor importance in light harness and heavy draught horses which usually wear a winker-bridle, though some horse owners strongly object to purchase an animal with a corneal opacity. It is most serious in saddle-horses—hacks and hunters—though frequently horsemen attach little importance to this defect when the horse in all other respects is suitable for the purpose required. Corneal opacity may cause shying, and in hunters it may lead to accident in jumping. Recent corneal opacities properly treated seldom extend their borders ; they tend to become smaller and clearer, and eventually transparent, though sometimes they increase in density, and a dense opacity is likely to be permanent. Even a " whip-mark " which at first is not completely opaque may result in permanent limited opacity of the cornea.

Cataract or opacity of the lens or its capsule is usually regarded by horse owners as a more serious defect than opacity of the cornea. This view may be due to experience of horses with cataractous eyes or to information concerning the effects of commencing cataract in the human eye. Probably, like man, the horse realizes the alteration in vision produced by incipient cataract, though frequently the existence of small cataract is not manifested by symptoms of impaired sight.

Cataracts vary in size from a mere speck or pin's head to a conspicuous patch of opacity, or, in some instances, a completely opaque lens. Occasionally two or more cataracts are present in one eye. The larger opacities obstruct vision, but the smaller may not seriously interfere with the horse's usefulness for any class of work. The position as well as the size of the cataract should be considered in advising the purchaser of an affected horse. Centrally placed opacities, even when small or difficult to discover, are often associated with hesitating movements and shying, while peripherally placed small opacities appear to have little influence on the horse's behaviour in harness or under saddle. Cataract may be due to heredity or to injury or disease of the eye. Every cataract constitutes an unsoundness, and the importance of the opacity largely depends on the probability of its extension or increase resulting in blindness. Congenital cataract seldom undergoes any appreciable alteration during life, and acquired small opacity of the lens, when arising from accident or injury to the eye, may remain unaltered for many years. Cataract resulting from an attack of specific ophthalmia is a very uncertain defect. In most cases the opacity extends and eventually the whole lens becomes involved, a termination which is hastened by every subsequent attack of ophthalmia. Years may elapse between the inception of cataract and complete loss of sight, though sometimes within six months the lens is no longer transparent. In forming an estimate of the risk in purchasing a horse with cataract, the examiner should assure himself that the defect is really a lenticular opacity and not a spurious cataract or the product of a recent attack of ophthalmia. Spurious cataract is the term applied to a small mass of fibrinous exudate in the aqueous humour, more or less obstructing the pupil, and free or floating or attached to the iris or the capsule of the lens. This sort of opacity in time tends to diminish and disappear, but it should always be regarded as a serious defect, for its presence indicates antecedent disease of the interior of the eyeball. The various methods employed in the detection of opacity and other defects of the eyes are described under " Diseases of the Eye " (p. 743 *et seq.*), to which the reader may refer for further information. Here it is desirable to state that of the many methods of examining the eyes of the horse the most reliable in routine practice is that which is carried out in natural light, the horse facing north, standing under an arch or in a doorway, while the eye under examination is shaded by means of a black hat, fan, or shield held in front of the orbit. By this method the examiner with average vision will be able to discover defects of the cornea, iris, and lens, and in any doubtful case he can make a further examination by resorting to the ophthalmoscope or to the catoptric test. Faint opacities of the cornea and minute cataracts are less likely to escape observation than immobility of the iris—a condition which is sometimes overlooked. While the horse is under examination the examiner has many opportunities of noting the activity of the iris. A glance at the pupils before the horse leaves the stable, followed by another view of the eyes after the horse has been brought outside, or on pulling it up after the test for wind, should enable the examiner to judge the condition of the iris.

In aged mares and geldings, and perhaps more frequently in stud horses, the pupil gives a whitish or bluish reflection which is suggestive of cataract, though usually the lens is quite free of definite opacity. This peculiar appearance is due to defective refraction of some of the lens layers, the light being partially reflected owing to increased density of the cortex or of some of its laminæ. The bluish-white reflection is more noticeable as the cortex layers increase in density or more closely approach the condition of the nucleus. It is a sign of retrogression, quite consistent with advancing age, and in the stallion the change appears to be hastened by masturbation and much service at the stud. Under the catoptric test the transparency of the lens is somewhat impaired, the middle and deep images of the flame are blurred or badly defined, but in most cases no isolated opacity can be discovered. In the absence of a definite opacity, duplication or blurring of the images of the flame should not be considered as amounting to an unsoundness. The horse's sight may not be perfect, it may be slightly impaired, but it is likely to continue serviceable for many years.

Blindness due to cataract offers little or no difficulty in diagnosis. Blindness (amaurosis) of both eyes is more easily recognized than blindness of one eye, especially when the loss of sight arises from paralysis. In any case of suspected one-sided blindness the sound eye should be carefully covered while the suspected eye is under examination. The usual tests should be applied indoors or in a calm atmosphere. In the trot a blind horse lifts its feet rather high and its ears are in constant motion. In walking or trotting over small obstacles and a white cloth placed on the ground it should blunder at the first and show no sign of boggling at the second. In certain cases a further test may be tried: With the points of two or three fingers firmly tap its face below the suspected eye, then make a feint to repeat the stroke and note the effect on the horse of the two movements. Repeat the stroke on the face and the feint to strike, and follow this by directing a finger on the cornea—a movement which few seeing eyes will tolerate.

Age.—In judging the age of the horse, attention is given chiefly to the lower incisors and particularly to the corner teeth, which are the youngest in the mouth. The tushes are too variable in eruption and wear, and, in the mare, too rudimentary to afford reliable information, and the molar teeth are only referred to in very young animals in which, owing to various causes, the indications of age furnished by the temporary incisors may be doubtful. The age of thoroughbreds can be ascertained from the General Stud Book, and in many instances that of shires, hackneys, and other pedigree horses from the stud books of the respective breeds. In the United Kingdom the age of thoroughbreds is reckoned from January 1 and that of half-bred horses from May 1, but in New Zealand, Australia, and South Africa the date is August 1.

In practice it is customary to qualify the estimated age of any horse examined a month or two before or after the recognized date of birth by adding " rising " or " off " to the stated age. Thus a horse described as *rising* five is one approaching the age of five years, or nearer five than four, while one described as five years *off* is a few months over five years old. Thoroughbreds may be described as " aged " after six, and other horses after eight years. The temporary incisors should be carefully distinguished from the permanent teeth. Compared with the permanent the temporary incisors are shorter and whiter; they have a constriction or neck between the fang and the free portion or crown, a shallow depression or cup on the table or wearing surface, but are not grooved on the anterior surface—that next the lip. The permanent incisors have no constriction or neck, but they have a deep cup, " mark," or infundibulum on the wearing surface or table and a vertical groove on the labial aspect. Distinction is readily made when both temporary and permanent teeth coexist, but temporary incisors alone, especially in ponies, may mislead the examiner, and a two-year-old may be mistaken for a five-year-old mouth. Occasionally difficulty arises in judging the correct age of a colt or filly owing to the state of the temporary incisors, which may not be very different at the ages of one and two years old. When doubt exists, the number of molar teeth in position should be ascertained. At one year, four molars—three temporary and one permanent—should be found on each side of the lower jaw, and at two years a fifth molar—the second permanent—should be cut or coming into position.

The ages of three and four seldom offer difficulty, but considerable latitude is exercised regarding the indications of five years old. An "Irish five" and a "Yorkshire five" are four-year-old horses from which the lower corner temporary incisors have been removed in order to hasten eruption of the corresponding permanent teeth. This trick, which is well known, seldom succeeds in deceiving any one, and its performance should be condemned as cruelty to the horse. Extraction carefully performed at the proper time promotes the cutting of the permanent incisors, but when practised too soon, or before the horse is four years and a half old, it tends to retard eruption by toughening the gums. A horse is five years old when the permanent lower corner incisors are level with the other teeth and the tables of the upper and lower incisors are in contact in the closed mouth, but for some months after this, the posterior edge—that next the tongue—of the corner incisors will not be in wear or as high as the front edge of the same tooth, and, as a rule, when both edges are in wear or the table of the crown is fully formed the horse is nearly five and a half years old. After this period the age can be judged more or less correctly by noting the shape of the tables, the relation of the teeth to the jaw, and the appearance of the wearing surface of the crown. At first the outline of the table is compressed from front to back, or elongated laterally, and as age or wear advances and the teeth are gradually pushed from their sockets, it becomes oval, then rounded, then triangular, and ultimately elongated from front to back or flattened from side to side. At the same time the teeth appear to lengthen, wear being less rapid than propulsion, they gradually grow more oblique in position and, in consequence, the angle formed in the closed mouth by the upper and lower incisors becomes more and more acute until, at twenty and onwards, the lower teeth are nearly parallel with the long axis of the jaw. Concurrently with these changes the tables undergo certain alterations, which alone, were they constant or invariable, would enable the age to be exactly determined. The popular view that the cup, infundibulum, or so-called "mark" is absent from the central incisors at six, the laterals at seven, and the corners at eight years, is only sometimes correct. The disappearance of the cup is so variable as to render it unreliable as an indication of age. In conjunction with other features of the table the mark is useful in estimating age between five and nine years, but owing to variation in the rate of wear or in the depth of the cup of the teeth of different horses and sometimes of the contiguous teeth of the same horse, the mark may be worn out before the recognized time or it may persist long after that period, as happens in "shell teeth" in which the cup is plainly evident in very old age.

At six, or soon after, the upper corner tooth presents a hook or unworn prominence at the outer angle and the tables of the central incisors are worn or quite level and nearly oval in outline. At seven, the hook of the upper corner tooth is longer (sometimes it has been chipped off), and the tables of the lateral incisors in wear and outline resemble those of the centrals at six years. The cup is narrower and nearer the posterior edge of the tooth. At eight, the incisors are more oblique, the tables level, and the posterior border of the corner tooth is worn. The centrals and laterals are oval, while the corners are approaching that shape. The cup or mark, still traceable, of the corner tooth is close to the hinder edge of the table. At this age, "the dental star" of Girard, a faint, yellowish line or streak between the anterior edge and the site of the cup, appears on the tables of the central and lateral teeth. The dental star represents the dentine of the pulp cavity of the tooth, and as wear advances this mark appears to change its form and position on the table. At first it is narrow and elongated transversely, then losing length it increases in thickness and gradually assumes a triangular or rounded form as it approaches the centre of the table. In old horses the dental star may be mistaken for the remains of the cup or mark, from which it differs by having no ring of enamel.

Galvayne's groove, a shallow vertical depression on the outer surface of the upper corner tooth, when rightly interpreted, is a very useful guide in judging the age of old horses. It appears at nine, close to the gum, and progressively lengthens with age or wear of the tooth or as it is pushed from its socket. At the age of twenty or twenty-one this groove extends to the edge of the wearing surface or table, and its upper extremity is just beneath the gum or receding from it. After this period the space existing between the gum and the upper extremity of the groove approximately indicates the age up to thirty years or more. In some horses this groove is absent or badly defined. In very old age the lower incisors viewed from the side are almost horizontal, very much diminished in curvature and transverse diameter. The peripheral enamel is extremely thin, especially at the posterior border of the wearing surface, which is triangular, and the dental star forms a rounded mark on the centre of the table. The fangs, which in early life were inclined towards the mesial line of the jaw, are now parallel, the crowns converging, and the spaces between the teeth are occupied by triangular projections of the gum.

Parrot mouth, or overshot jaw, and the rare condition pig-mouth, whether due to excessive length of the jaw or teeth or to restricted development of one jaw, are deformities which vary greatly in degree and in their effects on the wearing surface of the incisor teeth. In many instances the age can only be guessed or approximately estimated. Cribbing, too, may so alter the incisor teeth as to cause much difficulty in fixing the age of the horse. Cribbing usually results in conspicuous wear of the anterior border of the tables, but sometimes the posterior border is also worn, and in horses which have the habit of rubbing the teeth on the manger or playing with the collar chain the wear may be vertical or between the crowns of the teeth.

Bishoping is less extensively practised now than formerly, probably because less attention is paid to the mark or cup as the principal indication of age. Bishoping consists in giving the appearance of younger age to the teeth of an old horse. The teeth are filed, shortened, and trimmed into good shape, and a small excavation is made in each table by means of a burr, fine chisel, or gouge, the artificial mark being darkened by applying silver nitrate or the point of a special cautery. However artistically executed, the sham marks of Bishoped teeth are easily recognized. In the closed mouth the tables of the upper and lower incisors do not correspond, spaces exist in front between the arches, the false mark is devoid of a circle of enamel and its margin is not in relief. The trace —if any exist—of the genuine mark is posterior to the false one; the shape of the tables is not in keeping with the size and position of the artificial mark, and, generally, there are indications of the use of a file on the incisors and on the tushes, which are shortened, sharpened, and very nicely trimmed.

(For further information, see "Dentition," pp. 1094-99.)

Wind.—The principal unsoundnesses of wind are whistling, roaring, broken wind, wheezing or thick wind, chronic cough, and sometimes grunting. Other objectionable respiratory sounds are emitted under exertion by some horses, but unless the particular noise can be connected with disease, injury, operation, or acquired alteration of structure it should not be regarded as a sign of unsoundness of wind. Trumpeting, snorting, and flapping the wing of the nostril are bad habits or vices, offensive to many horse-owners, but without appreciable influence on the efficiency of respiration. High-blowing may be due to excitement, showing condition, or freshness in a horse of high courage. It should disappear under exercise or as the horse settles down to steady going. Grunting is a peculiar noise produced in forced expiration by some horses when suddenly struck or threatened with a stick directed to their ribs. Such horses may grunt in jumping—rising or landing at a fence, when starting a load, or in lying down or rolling in the loose box. More attention has been given to grunting since the revival of the laryngeal operation for the relief of roaring. Horses which were affected with roaring or whistling but quite free of grunting before undergoing this operation, grunt badly after its performance, and usually the noise emitted by the habitual pre-operation grunter is very much aggravated by the surgical treatment. This strongly suggests that horses in which grunting can be connected with the laryngeal operation or its effects should be regarded as unsound in wind, though probably such horses when galloped will emit a modified whistle or roar and be rejected as unsound apart from any question as to grunting. Horses that have not been subjected to any sort of laryngeal operation may or may not grunt when threatened or otherwise tested. Some grunt and, when extended, also roar or whistle; others whistle or roar but do not grunt at any time; while many grunt but neither whistle nor roar.[1] Roaring and whistling only differ from each other in the timbre of the sound, which is higher-pitched in whistling than roaring. Both sounds are emitted during the intake of air or inspiration, and in most instances, probably 99 per cent of chronic roaring or whistling, they are due to partial respiratory obstruction arising from passive movements of the arytenoid cartilage or paralysis of the dilator muscles of the larynx. Roaring, more or less acute, may be temporary and symptomatic of laryngitis, pharyngitis, nasal obstruction, strangles, glanders, impaction of the guttural pouch, purpura, influenza, pneumonia, and other diseases, but horses affected with one or another of these diseases are very seldom submitted to examination for soundness. Occasionally roaring or whistling is due to a cause acting mechanically by compressing the larynx as a tight throat-lash or bearing-rein, a severe bit, or excessive flexion of the head on the neck.

Rarely chronic roaring or whistling may be intermittent and dependent on the condition of the horse at the time of examination. But alleged intermittency of either defect should always be regarded as doubtful until a thorough test of the horse's wind has been made. A horse that has been idle and not exercised for some time may plainly whistle under very slight effort the first time he is tried for wind, and at subsequent tests the sound may be indistinct, less loud, or it may require longer exertion for its production, but as a rule the horse is not sound in wind. Idleness, gastric or abdominal distension, indigestion, and constipation temporarily influence the quality of the sound, making it louder and more easily elicited. Careful exercise and judicious feeding also have an influence in certain cases of roaring or whistling by diminishing the noise so that it is less audible or less easily provoked. Roaring may be modified or, as is said, " greatly improved " by the laryngeal operation, but very few roarers or whistlers are cured or rendered quite free of noisy respiration by this treatment. The general result is subdued roaring, mainly differing from the pre-operation sound by lowness of pitch and in many instances by duplication, the noise being emitted during both inspiration and expiration. And a more satisfactory result can hardly be expected from the current laryngeal operation. Excision of the mucosa of the ventricle of one or both sides of the larynx in order to effect closure or obliteration of the pouch, with consequent removal of the cause by which the arytenoid cartilage is pushed towards the air passage, would seem to be based on faulty conception of laryngeal function. Operators appear to assume that the ventricle is distended by the intake of air and that its distension is responsible for the arytenoid obstructing *inspiration*, but the fact is, the ventricle is virtually empty during *inspiration* or when roaring is produced, and is only distended with air during *expiration*, in the same way as are the other accessory cavities connected with the respiratory tract. Fixation of the passive arytenoid on one side or both is necessary to the prevention of the noise and distress, and when this can be effected without resulting deformity of the larynx, some method of laryngeal operation will supersede tracheotomy for the relief of roaring.

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[1] Further information on grunting and its relation to roaring or whistling may be found in *The Jour. Comp. Path. and Therapeut.*, vol. ix. pp. 112-19.

The origin of roaring or whistling in a horse may be due to heredity or it may be unknown. The noise may arise quite suddenly, without premonitory symptoms or any sign of illness, and this should excite no surprise, for in animals as in man the inception of paralysis is often sudden and not associated with a known or an efficient cause. Sometimes, however, there is knowledge of the horse having had a cough or a common cold with slight nasal discharge or sore throat a few weeks prior to the beginning of the noise. In many instances the occurrence of roaring is preceded by a more or less severe attack of strangles or other systemic disease.

The duration of chronic roaring or whistling in any case can very seldom be determined with accuracy, and in most cases unaccompanied by signs or traces of causative or coincident disease, estimates of the age of the defect can only be approximate. When roaring or whistling is only discovered two or three months after the date of purchase of the horse, it is inequitable for the buyer to insist that the horse must have been unsound in wind at the date of sale. The inception of the defect cannot be established by belated discovery, and although the purchaser may be quite conscientious in making his claim, the necessary proof cannot be obtained. Cases in which the defect of wind has been discovered within a few days or a week or so of the date of purchase are usually less difficult to decide. The condition of the horse, his behaviour while undergoing the test for wind and the character of the noise are helpful in forming an opinion of the duration of whistling or roaring. The progress of roaring and whistling varies considerably in different horses, depending in some measure upon the animal's constitution, the state of his blood circulation, and the nature of his daily work. Idleness or insufficient exercise tends to aggravate roaring, as happens sometimes with stallions which at the beginning of their stud career were only thick-winded. Roaring, slight at its inception, may rapidly become worse and render the horse unfit for fast or heavy work. Moderate roaring in some horses undergoes little or no variation for many years. Occasionally a moderate roarer improves, that is, he makes less noise and exhibits less distress under exertion. A whistler may become a roarer, but a roarer seldom or never becomes a whistler. Whistling is much more likely than roaring to remain stationary, without modification or increase of the sound. A slight whistler may only whistle slightly throughout a long life. As a rule, roaring or whistling is contracted before maturity or before the horse completes his fifth year, but there are many exceptions, and age alone has no controlling influence on the occurrence of unsound wind. Roaring, probably because it induces greater respiratory distress in fast or heavy work, is more likely than whistling to affect the horse's condition. Roarers doing heavy work may continue thin though well fed ; others well fed and not overworked may be distinctly emaciated because of defective wind and impaired circulation. The distress arising from roaring reacts on the heart and lungs, and if relief be not afforded the horse remains in poor condition.

Thick wind or wheezing is common in aged horses that are well fed, underworked, or not sufficiently exercised. Fat horses, especially ponies, are often wheezers. It is a chronic defect, and one that is more likely to increase than diminish, though care in feeding and regular exercise may bring about considerable improvement of the horse's wind. Wheezing may be due to thickening or œdema of the mucous lining of the bronchial tubes, larynx, or trachea, or occasionally to bronchial spasm. Thick wind may arise from a common cold, sore throat, laryngitis, strangles, bronchial catarrh, or a mild attack of pneumonia, and sometimes it is associated with limited emphysema of the lungs and cardiac dilatation. It may coexist with roaring or whistling and chronic cough, and frequently it is the forerunner of asthma or broken wind. Though not usually regarded as hereditary it is a serious unsoundness of wind because of its persistence and probable sequelæ.

Broken wind is common in ponies, and it occurs in worn hunters, hacks, harness or draught horses—light and heavy. It is an affection of middle and advanced age. In broken wind there is a characteristic cough, the movement of the flank in expiration is double, the lungs are more or less emphysematous and, in chronic or established cases, there is dilatation of the right heart and of the stomach, with indigestion, flatulence, and drooping of the belly—symptoms strongly suggesting functional derangement of the vagus nerve. Broken wind varies much in degree or in its effect on the horse's capacity for ordinary work in harness or saddle. It is a progressive disease, becoming gradually worse in most cases, but it can be checked to some extent by careful dieting and intelligent employment of the horse, especially just after a full meal. As a rule the subjects of broken wind are remarkably good feeders, some have a voracious appetite, though they seldom appear in first-rate condition, being often hidebound, with a dull, dirty coat. For a limited distance, as a mile or so, many badly broken-winded horses are as good as ever they were in pace and action, provided they are not pushed on a full stomach. Longer effort tires them, they lean on the bit, lose energy, and are soon fatigued if not quite exhausted. At rest in the stable the horse's breathing varies a good deal, depending on the quality and quantity of his rations and the state of his digestion. Outside, at work, the dyspnœa is always aggravated by thick, foggy weather.

Broken wind may be recognized by noting the character of the horse's cough and by watching the movement of his flank. The peculiar, hollow, wheezing cough is diagnostic of broken wind. It may be heard while the horse is feeding, or drinking, and at exercise, or on pulling up, and usually it can be produced by compressing the larynx. It is exceedingly difficult, if not impossible, to suppress the cough for any great length of time, and although horse-copers are said to be able temporarily to disguise the double flank movement by dosing the horse with atropine, hyoscyamus, opium, lead, or lard, there is no sure method of concealing the cough. Double movement of the flank in expiration generally points to broken wind, though in rare cases it may be due to hydrothorax, lung consolidation, or diaphragmatic hernia. In any doubtful case, when the cough is uncertain, confirmation may be found by resorting to auscultation or percussion of the chest, or by severely exercising the horse. A horse that has been doped for the purpose of disguising an infirmity of wind is always sluggish, he refuses to go freely, and usually, while under the influence of drugs, his sight is dull and his pupils are dilated. In the gallop, a broken-winded horse, even when doped, emits a harsh, wheezing or snuffling noise. On pulling up after a thorough test for wind he exhibits abnormal movement of the flank, and very probably emits at the same time the peculiar cough, which cannot be concealed. Broken wind coexisting with roaring or whistling may lead to hesitation in diagnosis, and sometimes the rejection of a horse as unsound is based on only one of these defects, as during the gallop the harsh respiration of broken wind may be masked by the more audible sound of whistling or roaring, while, the cough being absent, no attention is paid to the movements of the flank.

Chronic cough is generally regarded as more important than any other because of its permanency and the frequency with which it appears to precede whistling, roaring, or broken wind. But any sort of cough, dry or moist, of recent or remote origin, constitutes an unsoundness while it lasts. Acute recent or temporary coughing may be associated with nasal catarrh, strangles, pharyngitis, laryngitis, bronchitis, or other respiratory affection. Chronic cough is one of the most annoying defects of the horse. Fortunately it is not common, for it is seldom curable. Usually it is a short, dry, high-pitched cough, repeated more or less frequently at long or short intervals, inside and outside the stable, without apparent or discoverable cause. It is said to be a " nervous cough " and due to laryngeal irritation, though often it is unaccountable. Chronic cough in any horse may disappear during the summer and return in the winter. In young horses it may be connected with the eruption of permanent molar teeth. It is met with oftener in light than heavy and aged than young horses. Its effects on the horse vary ; often they are slight and even after many months not very noticeable. In some cases the most conspicuous effect is slowly progressive loss of condition. In time, when the cough persists, whistling, wheezing, or broken wind is the usual termination. Chronic cough may be suspected, but it cannot with certainty be distinguished from any other similar cough, and no one can positively estimate its probable duration. In practice, when a horse, suspected of chronic cough, is found free of all other respiratory defects, and is otherwise suitable for the purpose required, the intending purchaser should be advised to obtain from the vendor a special warranty covering the cough for a reasonable time or long enough to permit of the horse's recovery from an ordinary or temporary cough.

Testing the Horse's Wind.—Various methods are employed according to the circumstances existing at the time of examination. Lunging properly carried out is a very searching test and quite suitable for either light or heavy horses. For unbroken animals lunging in a straw-yard or paddock, or turning the colt loose in a small field or a large riding school and hustling it round and round repeatedly, is usually sufficient, the turning and twisting of the horse moving at a rapid pace being very effective in eliciting the symptoms of unsound wind. Saddle and light harness horses may be galloped or lunged, and heavy draught animals may be lunged or galloped, or yoked singly or with another horse to a loaded or braked van and driven a distance at a smart trot over rising ground. Horses intended for fast work (hunters, race-horses, polo ponies, hacks) should be severely tested by galloping on soft ground and, if desirable, the examiner himself may ride the horse. The riding examiner learns something of the horse's manners, his mouth and mode of galloping, but in a high wind he may easily miss slight whistling, which the walking examiner, provided he has selected a good position, is more likely to hear as the horse gallops past him or when it is pulled up. As well-bred horses sometimes only whistle when moving at a slow pace it is advisable to begin the test by slowly cantering them to the right and left in a circle of about twenty yards radius, then subjecting them to a splitting gallop, finishing, if possible, at the top of rising ground. Some horses only make a noise at the beginning, others at the close of a prolonged gallop. The distance to be covered or the time required in a fair test cannot be fixed, because sound and unsound winded horses vary greatly in stamina and general condition. In every case the test should be thorough, or in other words, the horse should be kept going until the examiner is satisfied that its wind is either sound or unsound. Roarers as a rule give little difficulty, but whistlers, and especially alleged intermittent whistlers, require very patient testing. Many slight whistlers, which emit no abnormal sound when galloping, will be heard distinctly whistling within a minute or two after pulling up. Galloping may be supplemented by coughing the horse and noting the character of the cough, but in the absence of distinct whistling, wheezing, or roaring, this test is only reliable in cases of broken wind. "Bulling" or "ribbing the horse" to ascertain if he is a grunter has gained importance, as already mentioned, since the resuscitation of the laryngeal operation for roaring. The examiner must see that the horse is free from roaring, whistling, wheezing, broken wind, and any other discoverable infirmity of respiration, but he should not be too anxious to anticipate contingencies or too apprehensive as to its future soundness. Having made a careful examination of the horse he should decide there and then whether or not it is sound in wind.

Some horse dealers strongly object to the test for wind. They seem to imagine that the rapid exercise of galloping may be injurious to the horse's health, perhaps forgetting that if the horse were at liberty in a field it would probably gallop freely of its own accord. In a long experience the writer has found that when a horse is fit for work it is also capable of undergoing the usual test for wind without detriment or risk of suffering immediately from any ailment. Horse dealers occasionally object to the test because they know the horse is unsound in wind, while others more astute oppose the test and offer to guarantee the wind, though they know quite well that without lunging, galloping, or other test the state of the horse's wind cannot be ascertained. Lunging or galloping not only serves to answer the question as to the horse's wind but also furnishes the examiner with useful information regarding the limbs and action, as the enforced exercise usually accentuates the symptoms of slight or doubtful lameness which otherwise might be overlooked. Intermittent lameness like that due to aortic or iliac thrombosis requires for its manifestation rapid and sometimes prolonged exercise of the horse.

Blemishes, scars, marks of firing, etc., should not be neglected, because they depreciate the market value of the horse, and the purchaser may not be satisfied with an examination which ignores obvious defects. Chipped knees, capped hock or elbow, fired hocks, torn eyelid or lip, and in hunters and polo ponies bumped fetlocks and scarred coronets or pasterns, are amongst the commoner blemishes of horses. Firing marks may be very unsightly, and, though sometimes a hock has been fired with the object of strengthening it or preventing curb or spavin, the existence of such marks should induce the examiner to be extra careful in his palpation of the blemished part. Many blemishes are close to the border-line of unsoundness, and the examiner in giving his verdict should take into consideration the class of horse, its age, the kind of work it must perform, and its action. But unless the blemish diminishes or is likely to interfere with the natural usefulness of the horse it should not be regarded as unsoundness. Frequently, blemishes which may be considered of small importance are included with the horse's marks of identification, a practice which, when advisable, is usually quite satisfactory to the intending purchaser.

Vices and Habits, dangerous or not.—These are many and of varying importance, but only a few need be referred to here. Cribbing or wind-sucking may be inveterate and so advanced in its effects on the horse's health as to constitute unsoundness; otherwise it is a vice. A horse may crib by seizing the manger, collar-shank, or any projection in the stall or loose-box, or it may use a knee or other part of a limb as the point of support for its chin. A wind-sucking horse is said to "crib in the air," that is, without seizing any object or supporting the chin, and the habit produces no abnormal wear of the teeth. A cribber wears the anterior or posterior border of the incisors or the vertical spaces between these teeth. If the cribber or wind-sucker is unthrifty and hidebound it should be rejected, and either vice in a horse of good condition should be mentioned, as the habit is almost certain sooner or later to have a deleterious influence on the animal's health. Although excessive wear of the borders of the incisors is not always caused by cribbing it is strongly suggestive of that vice, and the examiner should not fail to report the state of the teeth. Wind-sucking may not be observed while the horse is under examination, but a chronic case may show marks of a throat-strap or other preventive contrivance. Licking, a variety of depraved appetite, is another bad habit which may or may not amount to unsoundness. It is incurable, though the horse may continue serviceable for many years. Weaving, whether acquired through prolonged idleness or by imitation of a weaving-horse, wears the fore limbs and leads to an unsteady gait. It is a bad habit which, unfortunately, may escape discovery until after the purchase of the horse. Vicious to shoe is a serious vice, and, when proved, sufficient to justify the return of the horse to the vendor even when a warranty of freedom from vice has not been obtained at the time of purchase. But it is necessary to be sure that the horse is really vicious to shoe, and the usual course followed in such cases is to send the horse to two or three different farriers for this purpose. Other vices or bad habits are: restiveness or restlessness, eagerness to start, jibbing in harness, backing when yoked, biting the rider, kicking, riggishness, running away either from fear or temper, vicious to groom, bolting food, slipping the head-collar, not lying down, stumbling, tripping, overreaching, forging or clicking, etc. Any vice or bad habit which seriously impairs the natural usefulness of the horse may be regarded as unsoundness, but in many instances the fault is insufficient to disqualify on that ground alone, and in the absence of a warranty of freedom from vice or bad habit the buyer has no remedy at law.

Conformation.—Opinion regarding the horse's conformation, which may be good or bad, is often a mere expression of taste or fancy and very seldom based on knowledge of anatomical structure. Horses of all shapes, some very unpromising, go well and last long, giving satisfaction, and buyers are not agreed as to the best or most useful formation of any part of the horse for work or wear. This is fortunate in the vendor's view, as otherwise there would be a poor market for horses not conforming to the buyer's standard. The examining veterinary surgeon should not concern himself with conformation, except in rare instances, as cases of parrot mouth, flat feet, turned-in toes, etc., when he may find it necessary to reject the horse. He should restrict his attention to the horse's utility and leave any question regarding its elegance, perfection of form or the opposite to the buyer. A horse should not, as a rule, be rejected because of bad shape, but when the veterinary surgeon is instructed to examine and, if advisable, to purchase the animal, he must exercise his judgment of conformation as well as soundness.

Veterinary Opinion.—In making the examination the veterinary surgeon is expected to exercise reasonable care, skill, and intelligence. He is only responsible for his opinion to his employer or the person who pays the examination fee. Responsibility is naturally increased when acting for the buyer and somewhat lessened when acting for the vendor, as the latter is unlikely to find fault with a favourable or too lenient opinion, while the former may be very particular, insisting on being informed of every sort of discoverable defect of the horse. When acting for buyer and seller jointly the veterinary surgeon is equally responsible to either party in the event of a dispute as to the horse's soundness. When employed as general adviser or agent to the intending purchaser the veterinary surgeon occupies a considerably different position, his function is enlarged, and he should act for his employer as he would for himself. He should be guided to some extent in his examination by the class of horse and the purpose for which it is required. He should not expect the same cleanness of limb in a made hunter or a seasoned harness horse as in a younger or untried animal, and, as a rule, he should make due allowance for the effects of work and wear in all horses over six years old. Aged horses of any class are likely to have several defects, but so long as they are free of serious disease or deformity, and, in the examiner's opinion, promise to prove satisfactory at work for a reasonable time, while an unqualified certificate of soundness may be withheld, probably one of serviceable soundness can be given. Inexperienced buyers too often insist upon buying only "a sound horse," refusing to consider one that may be quite serviceable though technically unsound. They should be advised to modify their views of soundness, and reminded that the horse, like man, varies greatly in his lease of vitality or capacity for work, and that a well preserved horse, though not altogether sound, may prove far more durable than an untried sound one. Horse buyers are apt to forget that veterinary surgeons are specially trained to assist them in this matter, and that if more reliance were placed on their advice there would be fewer disappointed horse owners.

The opinion may be stated orally or in writing, and the written opinion may take the form of a certificate, report, or letter of advice. Some veterinary surgeons never give a certificate because they consider that a report or an explanatory letter is more acceptable to their clients, while others, and they form the majority, give a certificate—a definite opinion of the horse's soundness, which in every way is much more satisfactory to both buyer and seller.

The certified opinion should include one of the following terms: unsound, sound, serviceably sound, serviceable for the purpose required; or as variants, workably, or practically sound, according to the view of the examiner. Sometimes under mistaken effort to avoid the consequences of error or negligence in making the examination the veterinary surgeon substitutes "no unsoundness" for sound, or "I find no unsoundness" for I find the horse sound, but this practice, when not illusory, is futile and ill-advised. The examining veterinary surgeon undertakes to perform a certain duty for an expert's fee, and if he has confidence in his judgment he should not hesitate to certify in plain and unmistakable terms that he finds the horse sound or unsound. He cannot hope to escape the penalty of incompetence, negligence, or bias by resorting to subterfuge or circumlocution in giving his opinion of the horse's soundness or unsoundness. He can only discharge his obligations to his employer by stating fully all the discoverable defects of the horse, qualifying or explaining their importance according to his judgment and experience, but nothing short of this will enable him to preserve reputation or avoid actions for negligence. Nor is the so-called protection clause, sometimes appended to the certificate, of any value. This clause, in effect, states that the veterinary surgeon refuses to accept liability for errors of description or of opinion regarding the horse. It is a confession of weakness, incapacity, or, at best, trepidation. Without protective effect it is superfluous, and its use should be discontinued as it is more likely to diminish than increase the buyer's faith in the proficiency and integrity of the examiner.

Certificates.—Certificates may be partly printed and partly written or wholly written on plain or ornamented paper, bearing the examiner's professional address. The phraseology should be clear and intelligible and not misleading. Many slightly different forms are employed, but any form that gives in readable order the name of the person for whom the examination is made, the age, sex, class, height, colour, and markings of the horse, its defects, qualified or not, with the opinion of the examiner will be sufficient. It is not imperative though customary to begin the certificate with "I hereby certify" or "I this day certify" or even "I certify," the main thing is to state the facts clearly and concisely. A copy of the certificate should be retained or the particulars entered on the counterfoil. The following copy of a form which has been used in London for nearly thirty years may be useful to any one engaged in examining horses for soundness:

CERTIFICATE OF
EXAMINATION AS TO SOUNDNESS

Date...... No.......
For......................
....
....
Colour and Sex......
Age......................
Height ....
Marks...................
....
....
Opinion.................
....
Defects ....
....
....
....
(Initials)

No.... Address...........
I certify that I have this day examined at the request of ....
....
the following animal......................

Colour and Sex.	Age.	Height.	Distinguishing Marks.

The said animal is in my opinion
....
Defects..
....
....
....
....
Date...... Signature.........

The **marks of identification** may be embodied in the certificate, immediately following the age and sex of the horse, or placed separately at the end. In addition to the colour of the horse's coat marks of recognition should include the most noticeable markings on the head, trunk, and limbs, and any peculiar or striking feature of any part, as lop ears, slit ear, notched eyelid, wall-eye, fawn-eye, torn lip, slit nostril, scars, blemishes, prominences, indentations, mule feet, calf knees, buck knees, sickle hocks, ewe neck, star gazing, etc. Care should be taken in describing the colour of the horse. The colour of the body and limbs may not correspond to that of the muzzle, but in any case of doubt the colour of the muzzle controls the description. An old grey horse may appear white, but white is only recognized in spots or patches. A wholly white coat is always called grey. A light bay may be confused with a light chestnut or a dun, and a roan with a grey. A dark chestnut or a dark brown may appear black except on the muzzle, and a dun may be very like a bay or a chestnut, but the "mule stripe" on the back or zebra markings on the limbs of the accepted dun should be helpful. Bays vary considerably, as do chestnuts and roans, but with a little attention to the colours they can be readily distinguished. Dappling of any colour should be mentioned. Piebald is restricted to association of black and white, while skewbald is applied to various combinations of white with bay, brown or chestnut or any colour except black. A coat spotted like a Dalmatian dog and other combinations of colour—often seen in circus horses—are described as "odd coloured." A "star" is an isolated spot, patch, or streak of white on the forehead. It may be a large, small, faint, broken, or crescentic star, or, when extended towards the face by a short, narrow line, a star and stripe. White confined to a portion of the muzzle, nostril wing, chin, or either lip is a useful mark. A snip or short, narrow, tapering streak of white on upper or lower lip, nose or chin, and flesh markings on the muzzle are very distinctive. White on the face is less useful for the reason that there is no agreement as to the exact position or extent of white indicated by the names list, stripe, streak, race, and blaze. A "white face" is one wholly white. Other marks like "socks," "stockings," white foot, white heel, and white coronet are well known. The tail may be docked or undocked, or it may carry grey hairs. The mane also may have grey hairs or it may be "hogged."

The height of the horse may be guessed or it may be measured by standard. J. M.

LAMENESS IN HORSES

Definitions are proverbially difficult to frame, and the most careful definition of lameness admits of exception and qualification. Fortunately every one knows what is meant by the word, and therefore failure to express in a verbal formula what is or what is not lameness is practically unimportant. To say that lameness is "a movement of the horse's limb accompanied by a halt, or some defect in action" is hardly accurate, and it is too wide, because the action under observation may be the natural gait of the horse. A distinction is sometimes attempted between lameness and stiffness, but it is not easy to differentiate between the two. A condition affecting one limb may make a horse lame, whereas the same condition affecting two opposite limbs would so balance his movements as to suggest stiffness. Old horses, like old men, are often stiff in their movements, not in one limb but in all, and also in the muscles of the body.

Lameness is a sign of disease or injury. It varies according to the nature and extent of the pathological alterations in the limb, and is modified by the temperament of the horse. Some horses exhibit pain, and therefore lameness, from causes which in another horse would induce little sign of discomfort. Percivall's definition slightly altered is comprehensive and practical: "Lameness is the manifestation in the act of progression, by one or more limbs, of pain, disease, weakness, deformity, or impediment."

Lameness arising from weakness may be seen in old horses, in those suffering from debility or fatigue, in influenza and other systemic diseases, and in horses with worn joints. Lameness due to deformity or impediment may be seen in cases of luxation, anchylosis, mechanical lameness, and rupture of the tendinous flexor metatarsi. Lameness arising from pain only, or from pain with inability, is shown in cases of muscular cramp, strain, certain wounds, bruises, and fractures. Sometimes lameness appears from disease or injury of other than locomotory organs, as in cases of pleurisy, hernia, and scirrhous tumour of the testicular cord, when the movement of a limb causes pain in the affected part and consequently lameness. All lameness is not due to pain, although much the larger part is, and, as a rule, the intensity of pain is proportionate to the degree of lameness. As the result of disease of a joint, sprain of a tendon, or fracture of a bone, pain arises, and any movement of the injured part increases the pain. Lameness is probably the first indication of injury to a limb shown by the horse, and often the only clear and definite symptom. Pain, as shown by lameness, may be acute though temporary, as when a horse hits his fetlock with the opposite foot. Pain due to some joint affections may be very acute when movement of the limb follows a rest, but disappears entirely, so far as is indicated by lameness, when motion has been maintained a little time. Pain due to inflammation, with infection or pus formation, increases until the pus escapes. The gradual increase of lameness generally denotes progressive pathological changes in the injured limb. When lameness is plainly due to pain, rest is required. If the degree of lameness is proportionate to the pain caused by movement, then the quality of the lameness should enable the observer to judge whether or not the horse may continue at work. In the majority of cases of severe lameness there can be no justification for working the animal, because work is then accompanied by constant pain. There are certain conditions of lameness in which motion is beneficial, as in cases of congestion of the sensitive laminæ of the foot, and in some cases of swollen legs. There are cases of thick leg resulting from lymphangitis, or from " grease," in which horses are permanently lame but in which the lameness is so slight and so much owing to stiffness of the limb that work may be considered justifiable.

Continuous acute pain in horses very soon produces constitutional disturbance, inappetence, and wasting of the body. The fact that horses work for years with such lamenesses as have just been referred to, and maintain their appetite and condition, is evidence that the degree of pain caused by work is not such as can be regarded as inhumane.

Probably 90 per cent of lameness in horses is due to pain, though mechanical impediment too is an occasional cause. Contracted tendons may result from a condition which was, but has ceased to be, painful. Bent knees and deformed fetlocks may cause lameness without the existence of pain, so also may fibrous anchylosis of a joint. Of course, these conditions may be accompanied by chronic inflammation, and often there is great difficulty in being sure that pain is absent. Disputes have frequently arisen regarding the existence of pain in mechanical lameness, and, as we are unable to elicit the subjective evidence in horses, the question is likely to remain undetermined. Analogous conditions may be seen in human beings, who confess that while they suffer more or less inconvenience they are free from pain.

Lameness may be due to suspension or loss of nerve power, as in the various local or partial paralyses. Great lameness is seen as a result of injury to the radial or the suprascapular nerve, but it depends upon inability of muscles to perform their functions. Following an attack of hæmoglobinuria extensive atrophy of the extensor muscles of the stifle or elbow-joint may occur: lameness is excessive but it is not due to pain, it results from inability of the leg to sustain weight owing to the inert muscles failing to hold the joint extended.

Causes of Lameness.—The causes of lameness are direct or exciting, and indirect, predisposing, or contributing.

The exciting causes are those which directly produce the lesions giving rise to lameness, as blows, wounds, bruises, strains, burns, scalds, electric shocks, and other injuries contracted by the horse in slipping, falling, half-falling, collisions, or from over-exertion. Inflammation, however induced, may be a cause, as in arthritis, myositis, strain of tendon or ligament, laminitis, and other diseases of the foot, in cracked heels, " grease " or verrucose dermatitis, and eczema of the limbs. Other exciting causes of lameness are: neuritis, nerve injury or derangement, as in shivering, stringhalt, cramp, and partial or local paralysis; arterial obstruction causing intermittent lameness, as in aortic, iliac, or axillary thrombosis; tumour formation on a limb; hernia, orchitis, hydrocele, scirrhous tumour of the testicular cord, when interfering with the movement of a hind limb; partial luxation or wrenching of a joint; ostitis of fatigue resulting from special effort or prolonged hard work; systemic disease, as purpura hæmorrhagica, influenza, lymphangitis, farcy, malignant œdema, etc., causing symptomatic lameness.

External violence is the most common and obvious cause, though serious injury often results from the movements of the horse plus his own weight unequally distributed. A horse at play may fracture a pastern by bringing a foot suddenly to the ground when the muscles of the limb, having momentarily lost their usual control, permit the bones of the pastern to assume an abnormal relation to each other. A horse may sprain a tendon by a false step, or even fracture a hip by a sharp sudden turn, as at polo, when weight is thrust upon a part unsupported by muscular action. In effect the injury resulting from a misdirected or uncontrolled action of the horse is similar to that produced by external violence.

Sprains of tendons or ligaments seldom occur as a result of excessive muscular contraction, though sometimes they are sustained towards the close of great muscular effort, as in racing, when the tiring muscles become exhausted. Usually strain is caused by weight being suddenly thrown upon the tendon or ligament when unassisted by the normal action of the muscles. So long as the extensors and flexors of the limb act together weight is supported by the elastic muscles, but when the muscles fail—it may be only momentarily—to act in concord, then weight is thrown entirely upon the unyielding tendon or ligament, with the result of either sprain or rupture. A simple example of this is the sprained ankle of man, caused by a misstep, or the " curb " which a horse springs when jumping a bank that gives way as his foot touches it. In neither instance is injury caused by excessive muscular contraction, but by the sudden lurch and failure of the muscles to regulate the movement.

Among causes of lameness the part played by bacteria should not be overlooked. The limbs of horses are very liable to injury, but the process of repair is active and the most formidable-looking wounds heal well so long as no infective complications arise. Bacterial infection is the direct cause of the unfavourable termination of many wounds and bruises, and it constitutes the chief danger in wounds of joints, tendon sheaths, and other synovial cavities.

An exciting cause may be of sufficient force to produce lameness in the best formed limb, but there are many lesions giving rise to lameness which would not occur without the cooperation of a predisposing cause. Disease may alter the strength or resistance of tissues and so render them liable to suffer from apparently trivial injuries, and other influences favour the origin of lameness when an exciting cause comes into action, though of themselves they would not give rise to it. These influences have very decided effect on the duration and termination of lameness, and they merit further consideration. They are sometimes in evidence at the purchase of a horse as well as during its working career.

Conformation.—By selection and breeding, man has obtained classes of horses specially suitable for different uses: for strength and for speed; some for walking and drawing heavy loads, some for trotting, and others for galloping. For each class a certain conformation is best, and the experienced eye recognizes at a glance the typical hunter, vanner, hack, or cart-horse. To put a horse of one class to do the work of another is to invite trouble. Certain peculiarities of conformation or structure predispose to lameness in any class of horse. Amongst the more important of these are bones which are relatively weak, soft in texture, not flinty, and round rather than flat, because they have a tendency to suffer in wear from inflammation and bony outgrowths; small, narrow joints, as small knees or narrow hocks, in which the effects of concussion are insufficiently or unequally distributed, and defective feet, as brittle hoof, thin wall or sole, shelly hoof, flat sole, weak or thin heels, feet too much spread, and club foot. A flat foot is more liable to injury than an arched one, and a thin or low heel is easily bruised. Brittle hoofs readily break and thus interfere with effective shoeing. A short, upright pastern is more exposed to jarring and to joint disease than one longer and more sloping. Pasterns which are very long, excessively sloped, or have too much play, predispose to strain of the ligaments or tendons. The out-turned-toed horse is more likely to hit his knee in the trot than the animal with a properly placed foot. "Sickle-shaped" hocks are supposed to be specially liable to curb. Long or weak forearms predispose to the early advent of bent knees. Bent knees and sprung fetlocks, by interfering with the rhythm or symmetry of movement, lessen power and hinder precision in locomotion. The horse whose tendons below the knee are small or "tied-in" is more liable to sprains than one with prominent tendons and stronger formation of limb. Horses which naturally lack muscle take short steps. Short steps increase work and retard speed. The flat-sided horse with a light middle can seldom be kept in robust health or good condition.

Age and immaturity have considerable influence on the inception of lameness. In very young animals the tissues of the body are tender and immature and easily damaged. This is partly compensated by the rapid repair of the injured tissue. Old horses, on the contrary, have firm and mature tissues which, though not so easily injured, are less rapidly repaired. Horses four years old or under that age cannot withstand hard work, a fact known to all large owners of working-horses, but not yet apparently fully recognized by military authorities. Some lamenesses are specially influenced by age. Thus splints seldom cause lameness in old horses, whilst navicular disease rarely appears before the age of six. The racehorse put to work at two years old is often a cripple at an age when other classes of horse show no sign of lameness because they have been allowed to mature before being worked. Premature work, before complete development of the bones, ligaments, tendons, and muscles, is responsible for the early appearance of splint, ringbone, bony enlargements, swollen joints, windgalls, and knuckling at the fetlocks.

Temperament.—Horses vary as much as men in courage and energy, and these two characteristics influence the wear of the horse quite as much as conformation. The best made horse without courage is an undesirable animal and infinitely inferior to a plain one that possesses this quality. As a rule a "slug" passes through life with less damage to his limbs than do other horses because he will make no excessive efforts. A horse may have too much energy, and some forms of lameness are seldom seen except in the tear-away animal.

Work.—The horse that has done no work should be sound in his limbs. Very few working-horses, six years old and upwards, have clean legs, free from blemish. Work is necessary to bring the horse to the highest state of usefulness. Without work the best muscular condition is never reached, and it is only when the muscles are in the highest state of tone and strength that work is most economically performed. Work not only hardens the muscles of the limbs, it increases the activity of all the organs of the body. Circulation, respiration, and digestion are, equally with locomotion, brought to the highest pitch of functional perfection. An inferior horse in hard condition will do more work with less fatigue than a better animal in lax condition. Half the sprains that cause lameness occur in tired horses or in those which are lacking in healthy, bodily vigour or that state of physical fitness called condition. When a horse is tired and leg-weary his muscles have to some extent lost their tone and energy and he more easily slips and stumbles. The better the horse's condition the greater the effort he can make and the longer he can stay. Overwork shows its effects upon even the strongest and best-conditioned horses, by causing them to tire, to sweat excessively, to fail in their appetite, and to lose weight. When overwork takes the form of too long a journey, too heavy a load, or excessive pace, it may cause serious injury to limbs or to lungs and other internal organs. If such effects are escaped, a rest for a day or two will enable a healthy horse to recuperate. When overwork is not quite so excessive as to produce the results just mentioned but is continued for weeks, horses gradually become debilitated and recuperation is slow even when complete rest is allowed. There is no economy in overworking horses. Lameness is sure to appear in some and enforced idleness is then inevitable. Should influenza or other infectious disease obtain entrance to an overworked stud, its ravages are ten times more severe than in one of fairly worked horses.

The ill-effects of overwork may be greatly added to by the driver. Some men will do the same amount of work as others and keep every horse they have in good condition. Some men injure every horse they have. Irregular changes of drivers, even if all are excellent, upset horses and detract from their working usefulness.

Shoeing.—Bad shoeing may be a direct or exciting cause of lameness. Injuries from badly driven nails and improperly fitted shoes produce some of the most serious forms of lameness, but these are soon detected and traced to their cause. Defective shoeing is also a predisposing cause of lameness and often it escapes immediate attention. By retaining the shoes too long upon the feet the hoofs become overgrown and out of proportion. A strain is thus put upon the ligaments of the joints above, and they are predisposed to further injury from comparatively slight exciting causes. By failing to have worn-out shoes replaced by new ones at the proper time, a shoe may be cast at work, and even when the hoof is not broken it is usually worn so thin that bruising of the sole is almost a constant result of the accident. By leaving the heels too high or the toe too long a disproportionate hoof is formed ; this alters the normal relation of the foot to the leg and exposes the structures above the hoof to strain. A common error in shoeing is to leave one side of the wall higher than the other, causing irregular lateral pressure to be thrown upon the lower side. When this fault is allowed to continue for a few months a permanent twist of the hoof or foot is evident at the coronet. It is rare now to see a hoof so pared as to yield to light pressure, but in times gone by the practice of excessive paring was common, and the pedal bone frequently showed atrophy and flattening as a result of unnatural pressure. Certainly the art of horse-shoeing has improved, but it is still not uncommon to see a shoe so fitted on the foot surface that no level bearing is provided. The shoe is bevelled out from the external border to the internal like a saucer and on this sloping surface the hoof has to rest. No worse fault could be committed, as the effect on the hoof is to maintain a constant pressure on the wall, forcing it inwards and predisposing to lameness even when direct injury is not inflicted.

Stabling has its effects on the limbs of horses. Slippery, greasy, or dirty flooring may lead to falls, half-falls, strains of ligaments, tendons, and muscles, and fractures, particularly of the pelvis. Insufficient litter, by leaving the floor sparsely covered, favours all the injuries resulting from a slippery surface. Insufficient bedding probably hinders some horses from lying down, though in London stables provided with ample litter many draught horses shortly after purchase refuse to lie down. Horses that persist in standing suffer from the effects of leg weariness, their limbs become permanently thickened, and in sleeping in the standing posture they frequently half-fall forward, knuckling and bruising their fetlocks. A stall too wide permits a horse to turn round and thus get cast. A stall too narrow prevents the horse from lying with comfort. The head-collar rope or chain may dangle and allow the horse to get his foot over it, when he may stand " sawing " the leg across the collar shank, bruising the back of the knee or, in attempting to free the leg, he may throw himself down. Bails are supposed to be more hygienic and economical than stalls, but experience suggests that if account were kept of all the accidents due to bails there would be shown a large profit from the use of stalls.

Roadways.—As is well known, stiff and lame horses no longer fit for use in towns may work satisfactorily for years in the country. Work on the land or on country roads is attended with more friction, but the foothold is better and there is less jarring than on paved streets. Roads and streets paved with stone setts and cobbles, and, during rain, snow, and frost, those laid with macadam, concrete, asphalt, or wood, contribute to the production of lameness by causing the horse to slip, fall, or half-fall. In this way sprains of ligaments and tendons, wounds and bruises are contracted, joints are wrenched and bones broken. Horses working regularly at a fast pace on paved streets sooner or later suffer from the effects of concussion. They lose action, acquire rounded joints and bony enlargements, and eventually, in too many instances, navicular disease. Horses doing slow draught work where the foothold is insecure, by slipping or half-falling when starting, holding, or setting back a load frequently contract bruises, strains, or limited fractures.

Heredity.—In horses various peculiarities of conformation, action, and temperament are inherited. Although heredity as a cause of lameness has not been proved, the transmission of a tendency to certain defects or diseases of the limb bones can hardly be disputed. There is no doubt that some forms of lameness, as spavin, ringbone, and navicular disease, are commonly seen in the offspring of horses affected with these diseases. The foal is not born with spavin, but it may have inherited from its sire or dam a peculiar weakness of structure or tissue which predisposes the bones of the hock to spavin disease. Frequently it has been observed that a very large percentage of the foals got by an unsound horse sooner or later develop the special unsoundness of their sire. The mare also transmits her unsoundness, and a very significant fact is that if sire and dam suffer from a similar unsoundness hardly a foal escapes the development of this defect. The recognized hereditary diseases associated with lameness are ringbone, sidebone, bone spavin, navicular disease, grease, stringhalt, shivering, and unsound feet.

Symptoms of Lameness.—Symptoms of lameness are the signs by which disease or injury of the limbs is detected and located. Some symptoms are noticeable when the horse is standing at rest, some when the limbs are in motion, and others only on close inspection and manipulation of the lame limb. A lame horse may stand as square on his feet as a sound one, but usually he gives evidence of pain or discomfort in a limb by " resting " it. The foot may be slightly advanced, or the fetlock joint may be half flexed and the heel of the foot raised from the ground. This position is assumed because the tension of muscles and tendons necessary to keep the leg extended causes suffering when a painful lesion exists in any part of the leg. Relaxation of tension affords ease and permits the bending of joints. The degree of bending is not in exact proportion to the quality of pain and is influenced by the nature and position of the injury. In many instances acute foot lameness is accompanied by notable resting of the foot, whereas a horse may be very lame from splint and not rest the foot at all. Bending the knee generally coexists with flexion of the fetlock, and is very evident in cases of severe sprain or injury to the tendons at the back of the leg.

As a rule, partial flexion of the joints of a limb is simply due to voluntary relaxation of muscular tension, but there are cases in which flexion is due to paralysis. These are distinguishable by presenting complete flexion of a joint which does not resume its normal position when the horse is forcibly moved.

" Pointing " is the term employed to describe a position of a foreleg in which the foot is placed on the ground in advance of the opposite foot while the knee is bent only very slightly or held extended. Although pointing is indicative of chronic foot-lameness, particularly navicular disease, it is also seen in other lamenesses, and occasionally it has been noticed in horses that are quite sound in action. Trembling and knuckling of the forelegs are noticeable in horses that are unsound in both fore-feet. They frequently accompany bent knees and straight fetlocks, conditions which indicate the effects of wear or premature work.

A horse is said to " nurse " his leg when he holds it up with the foot off the ground. This is often a sign of acute pain, and suggests that the foot is probably the part affected. In injuries to the foot complicated by pus formation, holding the foot raised from the ground is a prominent symptom. It is seen in cases of pricked foot, suppurating corn, complicated sand-crack, fractured navicular bone, open-joint, rheumatism, and very painful conditions of the hock and stifle.

The relative position of fore and hind feet is instructive, as when great pain affects both fore, the hind feet are placed well forward under the body so as to carry an extra share of the weight of the animal and thus relieve pressure on the fore-feet. Abnormal fixation of a limb is a rather striking sign of lameness. One joint or the whole limb may be fixed. A remarkable example of this is seen in outward luxation of the patella in which the limb is projected backwards resting on the toe-wall. Abnormal mobility is indicative of some important structure having given way, as in rupture of tendon or fracture of bone.

The action of the lame leg during locomotion, save in a few instances, is not diagnostic, but it is suggestive and it often discloses symptoms which are necessary or helpful to the formation of a correct opinion. If the observer knows how a horse moves the fore and hind legs when sound, he will quickly recognize the irregular way in which movement takes place when the horse is lame. At first he may not notice every deviation from the normal, but as his experience increases he will be unlikely to overlook any indication of lameness ; and if his attention is directed to it he cannot well be mistaken, although he may not understand its nature or see its significance.

Nearly every lame horse takes a shorter step with the lame leg than with the sound one. Movement of an injured leg or sustaining weight upon it causes pain, and therefore a short step is adopted to lessen pain. There are a few lamenesses in which the lame leg takes the longer step; for example, acute arthritis of the knee or stifle, wrenched hock, and suppurating toe sand-crack of the hind foot.

Adduction of a limb takes place when it is drawn unnaturally inwards during progression. Muscles on the inner and outer sides of the limb act together and the leg is brought forward in a more or less straight line. If from pain or incapacity one set of muscles ceases to act or the other set overacts, the limb is drawn away from its proper line by the stronger group. When the leg is adducted it is because the outer muscles are inactive or acting with less energy than the inner.

Abduction is applied to a movement in which the leg is drawn away from the body and the foot in passing forward is thrown outward. Both adduction and abduction are movements over which the horse has no control when they are due to incapacity or paralysis of the muscles. But either movement may be voluntary and resorted to by the horse to overcome a difficulty or to prevent or modify pain. If a horse suffers from a painful condition of the sternum, or a wound of the axilla, he may adduct the limb because any movement outwards causes pain. Abduction is seen in bruised hip, obturator paralysis, tumour of the groin, abscess formation in the upper region of either fore or hind limb, and in acute disease of the knee or hock which is stiff and very painful when flexed. Abduction of both hind limbs or a straddling gait is seen in orchitis, large scirrhous cord, acute hydrocele, mammitis, and fracture of the pelvic floor.

The movements of the foot during progression are important as symptoms of lameness. The manner in which the foot is brought to, laid on, and taken off the ground should be noted. When the heel of the foot is conspicuously brought first to the ground, usually a painful condition exists at the front of the foot. When the toe is brought to the ground and the heel is kept raised, it may be that the hinder part of the foot is the seat of pain, as in bruised heel. But a horse goes on his toe in many lamenesses not affecting the foot, as in active spavin disease and open knee-joint. He does so because the flexor muscles are employed to hold the limb steady and rigid and thus prevent pain from full extension of the affected joints higher up the leg. Thus the heel may be raised from the ground simply as a coincidence accompanying action adopted for a purpose quite independent of the foot. In very painful lameness, irrespective of the position of the diseased or injured part of the limb, the foot is placed on the ground gently and with hesitation because the jar of contact or the effort required to sustain weight is felt throughout the limb. When the bones or joints are the seat of acute pain, supporting weight upon the foot produces perhaps its worst effect, and in such cases, as soon as the foot reaches the ground, the limb slightly yields and the foot is as rapidly as possible raised again. In some cases, notably in complicated sand-crack, the foot is absolutely snatched off the ground, and in other cases the limb is carried, the foot not reaching the ground.

Certain veterinarians attempt a distinction in the symptoms of lameness by the terms "swinging leg lameness" and "supporting leg lameness." Whilst allowing that it may be possible in a few instances to note a difference between the signs of difficulty shown by the horse in moving the leg and his manifestation of objection or fear to bear weight upon the foot, the distinction has very little practical value either as helping description or diagnosis. Dragging the toe is a symptom seen both in fore and hind leg lameness. In the fore, usually it is due to inability of the shoulder muscles to raise the leg sufficiently for the foot to clear the ground. In the hind, it is mostly seen as the result of insufficient flexion of the hock or stifle. In the chronic case when the horse continues at work the toe of the shoe shows excessive wear, and thus another sign is given which assists diagnosis.

It is always important to note any abnormal motion of joints in a lame limb. A joint may be fixed, overextended, or overflexed. The two opposite feet should be raised at each step to the same height. When weight is placed upon the feet the same angle should be formed at the joint of one leg as at the corresponding joint of the opposite leg. In the hind limb the hock and stifle joints move together. They are so anatomically bound to each other that only when the connection is impaired or is broken can the one act out of unison with the other. Pain in the stifle gives rise to limitation of movement in the hock and *vice versa*. It is very difficult to say from action alone whether the pain is in the stifle or hock. In the absence of obvious or discoverable local alteration of either joint, and as stifle lameness is comparatively rare while hock lameness is common, want of free flexion of the hind limb may in many cases be safely attributed to pain in the hock.

Lame horses may exhibit peculiarities of action which are strongly irregular and very often quite diagnostic. In injury to the shoulder resulting in paralysis of certain muscles on the outer surface of the scapula, the point of the shoulder bulges outwardly at each step just when weight is placed upon the foot. In some ruptures of tendons such abnormal motion of a joint is permitted that the lesion causing it may be named without manipulation of the limb. Paralysis of muscles may also allow such definite alteration in the form or movement of a limb as to point directly to the lesion. In disease or injury of the spinal cord and brain the movements of the horse direct attention to the nature of the lameness. Sometimes the movements are convulsive, but more often irregular and indicative of loss of control. They usually affect the whole limb and often all the limbs, but the hind limbs are most likely to show plainly the effects of cerebro-spinal lesions.

The symptoms of lameness so far referred to are those which can readily be seen when the horse is standing or slowly moving. There are others which require closer examination for their detection and which are of much importance because they generally indicate the position of the lesion causing lameness.

Swelling of a limb is common. It results from œdema, injury, or disease, and varies considerably in its pathology. Probably the most common swelling is that which accompanies inflammation. It is firm and painful when pressed, and as a rule it does not extend far from the seat of injury. Swelling due to effusion of blood arises with great rapidity, as in speedy cut, and is the result of laceration of small blood-vessels. In fractures, the sharp edges of the broken bone may cut arteries or veins, causing extravasation of blood and very extensive swelling. In lymphangitis the whole limb is swollen to an enormous extent, and so it may be in farcy and in purpura hæmorrhagica. Swelling extending upwards from the heel and coronet is met with as a result of wound infection or "blood poisoning." It is remarkable for the intense pain accompanying it and the rapid formation of many necrotic abscesses in the affected tissues. Diffuse swelling of the legs below the knee and hock arises from many different causes. It is seen as one of the earliest signs of some forms of influenza. It may indicate rheumatism of the flexor tendon sheaths, or it may be connected with suppuration within the hoof. It is often produced by rubbing irritants into a lame leg, and then is a nuisance, because it covers and disguises lesions which otherwise might indicate the seat of lameness. The veterinary surgeon, arriving after the amateur has "used a little embrocation," has often to wait days for this swelling to subside before he can be sure of diagnosing the nature and cause of the lameness.

Œdematous swelling of the legs also results from debility and from disease or functional derangement of the heart, liver, or kidneys. Sometimes it is constitutional and associated with a lymphatic temperament. Frequently it is temporary and arising from indigestion. Swelling due to œdema or serous effusion pits on pressure and the impression made by the finger remains for some time. Œdema may coexist with inflammatory swelling in a lame limb, as in bruised knee with œdematous swelling of the shank—the œdema extending beyond the painful part.

Limited or well-defined swellings, compressible when recent, firm and resistant when old, may be seen at the fetlocks, knees, and hocks. They are due to distension of natural synovial cavities and are known as windgalls, bog spavins, and thoroughpins. They only cause lameness when injured or when the distension is so large as to interfere with the play of the tendons or the movements of the joint.

Outgrowth or enlargement of bone is common and as a rule is attended by lameness during the process of formation or while the bone is inflamed. Exostosis may gradually arise without lameness and may remain, when fully formed, without pain. Splints, spavins, and ringbones are examples of bony enlargements which nearly always cause lameness during their formation.

Pain may be the only indication of a lesion causing lameness. Pain may sometimes be discovered by movement of a suspected part. A joint may be flexed or extended and may thus give clear evidence of pain. An injured bone may sometimes be detected by gently moving it with the hands, but it should be remembered that some horses object to the most simple handling of their limbs. The temperature of a part may indicate the seat of injury. The foot, joint, or any part of a limb in which acute inflammation exists is usually warmer than the adjoining parts. Heat and cold are comparative terms and the hand that detects them is not always accurate in its estimate. In those rare cases of intermittent lameness due to obstruction of the blood supply, exercise, whilst maintaining or increasing the surface temperature of the sound limbs, leaves the unsound one remarkably cold below the obstruction.

Discoloration is not easily seen on the hair-covered legs of horses. In white-legged animals changes of colour may be noticeable, as in cases of cracked heels, when congestion or inflammatory redness of the skin is evident. In injuries of the foot discoloration is visible on the white horn. On the ground surface of the hoof changes in colour indicate two frequent causes of lameness—at the heels, corns, and round the toe, bruise from the shoe or a picked-up stone, or even moss-litter firmly caked under the shoe.

Deformities of limbs may be temporary or permanent. As the result of injury with swelling a joint may be so altered externally as to equal a deformity. Fractures produce deformities, some permanent. Fracture of the outer angle of the haunch is an instance. Fractures of the longer bones of the limbs of horses are seldom surgically treated. When they are, there are few that escape more or less permanent deformity. Ruptures of muscles or tendons may be attended by deformity, as in cases of "complete breakdown" in racehorses. Contraction of tendons, with or without adventitious adhesions, also causes deformity, as when the knees are badly bent, the fetlocks overshot, or the heel permanently raised from the ground. Dislocation of the joints of the limbs is rare in horses. When it occurs it gives rise to marked deformity which may be aggravated by coexistent fracture.

Crepitation is the crackling or grating noise which may be heard when the opposed surfaces of a broken bone rub against each other. It is quite diagnostic when present, but there are some cases in which care is necessary to distinguish it from sounds emitted by joints. A bone may be completely fractured and yet give no crepitus, because either displacement has not occurred, or blood-clot, muscle, or other tissue has found its way between the surfaces of the fracture.

Twitching of muscles is often noticeable in the region of a fractured bone. In fracture of flat bones (scapula, pelvis) covered by muscles, twitching is a useful guide in the first few hours following the accident. In comminuted and compound fractures of long bones, twitching is often continuous while the horse is standing. Spasm of muscles is seen in its most exaggerated form in acute tetanus. Muscular spasm may accompany abscess formation, rheumatism, acute arthritis, and laminitis of all four feet. In lameness connected with the shoulder (fracture, dislocation) the levator humeri muscle is spasmodically affected. When the horse is moved this muscle becomes rigid and is rendered very prominent. Cramp is uncommon in horses, but it has been observed affecting the extensors of the shoulder and the extensor (crural) muscles of the stifle. Rigidity of the muscles of the haunch, sometimes of the elbow, is seen in hæmo-albuminuria and in rheumatism of the neck and loins. A very curious spasmodic condition is shown in stringhalt. At rest the muscles seem normal, but on movement of the affected limb the foot is jerked up. In cases of intermittent stringhalt, movement is quite regular in the intervals between the abnormal contractions which appear to be excessive and hurried. In shivering affecting the hind limb the spasms last longer than in stringhalt. The limb is raised, abducted, and held quivering for a few seconds, then the foot falls quickly to the ground. Frequently in both stringhalt and shivering the symptoms are not conspicuous and only appear at long intervals.

General systemic disturbance very often accompanies the graver and more painful lamenesses. The symptoms usually are sweating and blowing, and later a rise of temperature, increased rapidity of pulse, and emaciation. Loss of appetite is a serious symptom when arising from lameness. As a result of wound infection fever is rapidly set up, and in some cases of severe injury to the leg or foot septicæmia often brings about a fatal termination.

Diagnosis of Lameness.—Diagnosis is the art of recognizing symptoms and correctly estimating their meaning and value. The diagnosis of lameness in horses is made solely from the objective symptoms. Subjective symptoms which are so helpful to the human surgeon are not available to the veterinarian. There was a time not long past when the belief prevailed that some men possessed an intuitive talent for diagnosing lameness, and there were even occasional veterinary surgeons who modestly claimed to possess this mysterious gift. In a few cases the experienced practitioner may exercise his snapshot diagnosis with great precision, but in the majority care and time and the most minute examination are necessary. When one has detected every symptom exhibited by the lame horse, then comes the time to weigh and balance them all, to put aside those which are accidental, to value those which are essential, and to draw an inference. Every case of lameness is a logical problem the solution of which requires technical knowledge and sound natural judgment. Experience, of course, assists men in diagnosing, but length of practice is not the measure of experience: two cases properly observed, studied, and understood afford more experience than twenty casually noticed and never mastered. A long experience includes many failures, and mistakes leave on the mind a deeper impression than successes. Few men make the same mistake a second time, and thus practice inculcates caution. Diagnosis of lameness may be easy or very difficult according to the nature of the case. Lameness varies greatly in degree. The defect in action may be intermittent, trivial, or so slight that doubt may exist as to which leg is lame. Often the lame leg is quite obvious. Sometimes the action of the horse suggests that it is lame on more than one leg, and this is not uncommon. All cases of lameness, and particularly those which are obscure, should be examined methodically. Method simplifies procedure. It ensures accuracy, imparts confidence, and saves time.

In diagnosing lameness the examiner should first ascertain which is the lame leg, then he should find the seat of the exciting cause of the lameness, and having found it he should make an effort to form a just estimate of the nature of the injury or lesion, its curability, and of the treatment required. Lameness arising from wounds and bruises of muscles usually offers less difficulty in diagnosis than that due to disease or injury of bones, tendons, or joints. A lame leg that is clean and apparently free from blemish often gives rise to misgiving in diagnosis.

Detection of the Lame Leg.—Movement of the horse, walking or trotting, is necessary in most cases. A slow trot with a loose rein is the best pace for disclosing lameness. The road should be paved or hard, with an even surface and a slight gradient. Trotting a slightly lame horse on grass or other yielding surface may mislead the observer. The animal should be led out quietly and slowly trotted for about thirty yards straight, turned, and trotted back to the observer. The distance of thirty yards is, of course, merely approximate, but a shorter distance may not clearly show slight lameness, whilst a run of sixty yards may temporarily remove the symptoms of a chronic case.

Front-leg lameness is best seen when the horse is coming towards the observer, and its indication is a nodding movement of the horse's head—the head rising when the foot of the lame leg is on the ground and falling with the sound one. Hind-leg lameness is best seen as the horse trots from the observer, and it is shown by a sinking of the quarter on the sound side at each step. The head may rise and fall in hind-leg lameness, but the head rises when the lame leg comes to the ground. In many lamenesses of the hind limbs there is no "nodding" of the head.

It is not always easy to distinguish the lame leg. A horse may be lame on one, two, three, or even all four legs, though few horses are lame on more than two at the same time. Only a novice can be doubtful in deciding between a left and right front, or a left and right hind limbs, but an experienced observer may be puzzled to decide between the diagonal limbs—between a near-fore and an off-hind, or a near-hind and an off-fore—of "cross lameness," in which a horse lame on only one limb gives the impression of being lame on two. Still more puzzling is the horse that is really lame on both diagonal limbs. Lameness affecting the fore and hind limbs of one side may cause the observer to hesitate, especially if the degree of lameness in front and behind is nearly equal. A horse lame on three legs—as one fore and both hind—may lead to error in diagnosis. The inexperienced observer may know the symptoms of lameness, but until he has had considerable practice in watching lame horses he will continue more or less uncertain of the lame leg. Mistakes in detecting the lame leg are frequently made by horsemen and others who ought to be familiar with lameness. A groom's diagnosis of the lame leg is often wrong, and it should not be accepted without verification.

In making an attempt to distinguish the lame leg, the observer should watch the horse's head in front lameness and the quarters in hind lameness. He should not attempt to watch both ends of the horse at the same time. Neither should he try to distinguish the lame *front* limb while the horse is moving from him, nor the lame *hind* limb while the horse is coming to him. That the expert may do, though seldom that alone. He should pay special attention to the movements of the limbs when the horse is turning, and in some cases he should take a side view of action while the horse is trotting past him.

The beginner in directing his eyes to the head may have an inclination to look at the horse's feet. This should not be encouraged, at least not at first, or until he has acquired sufficient ability to detect the lame leg at a glance. Next he should endeavour to enlarge his view, and with a little practice and by training his eyes to see more and more at each attempt, he should soon be able without effort to cover in one view the head, shoulder, knee, shank, pastern, and foot in front lameness, or the quarters and limb downwards to the foot in hind lameness. He should bear in mind that while the head falls with the sound limb in well-marked front lameness, it may fall very little when the lameness is slight, and in trivial or doubtful front lameness the head may not yield at all. He should not forget that in hind lameness the quarter of the sound limb gives, sinks, or falls when the foot of the lame leg comes to the ground, and that in some cases the head rises at the same time. To reach a positive conclusion in diagonal or "cross lameness" the safest way for the observer is to have the horse trotted at short intervals until he is quite certain of the lame limb or limbs, watching, always separately, the movements of the fore and hind extremities. In some foot diseases both fore-feet are equally affected, and when the defect is slight it is not easy to decide whether the horse is lame or stiff, or merely possessed of low or bad action. It is seldom that lameness equally affects both hind limbs. It may, however, occur from lesions of the feet or hocks, and in either case the horse's action suggests injury to the back or spine. Stiffness of both hind limbs renders the motion of each similar and causes a movement which may be described as crouching. In those cases, where both fore or both hind limbs appear more or less lame, the horse should be exercised and, in doubtful hind lameness, with weight on his back. Twenty minutes' trotting exercise followed by a rest of half an hour and another run out in hand will in most instances settle the point by increasing the lameness or by leaving the action of the limbs unaltered.

There are intermittent lamenesses which, when the veterinary surgeon examines the horse, may not be visible. Under such circumstances a trial should be given under the same conditions as existed when the horse showed the lameness complained of. It may be that a trial in harness or in the saddle is necessary to bring out the symptoms, and such trial should last a little longer than the time which elapsed when the defect was shown.

Detection of the Seat of Lameness.—Having ascertained which leg is lame, the next step in diagnosis is to locate the seat of the exciting cause. This may be quite obvious or it may have been discovered while the horse was trotting. Often, however, the seat is not evident, and a careful examination of the whole limb is necessary. While the horse is trotting close attention should be given to the action of the lame limb. By watching the way the foot is brought to and placed upon the ground, the movement of the fetlock and pastern, the flexion of the knee or hock, the play of the shoulder or stifle, and the carriage of the quarters, symptoms may be seen inviting attention to one or another part of the lame limb. For example, in shoulder lameness there is restricted movement of the scapula, the step is short or swinging, or the point of the shoulder appears to have too much play. In carpitis, knee-splint, and acute thoroughpin the knee is stiff, extended with care, and only partially flexed. In acute flexor strain, the knee, not fully extended, tends to lean forward, and the heel of the foot rests lightly on the ground. In fetlock injuries the joint is fixed or carried stiffly. In hind lameness, a "bobbing" movement of the quarter on the lame side suggests disease of the hock. When the quarter is carried high with abduction of the limb the seat of lameness usually is in the hip (fracture, bursitis, etc.), and when the quarter is carried high without abduction most often the fetlock is at fault. A peculiar hitching movement of the hind limb in the trot is characteristic of stifle injury which is nearly always accompanied by deformity of the front of the joint. In flexor metatarsi lameness the carriage of the hock and relaxation of the Achilles tendon are quite diagnostic.

Assuming that observation of the movements of the limb has failed to discover the seat of lameness, examination with careful palpation or manipulation of joints, tendons, and ligaments should be practised, beginning always with the foot. Frequently the foot has been examined by the farrier, but this should not hinder its further examination by the veterinary surgeon, who is responsible for the diagnosis and treatment of the lameness.

In all cases, fore or hind, the foot should be examined, for although an obvious or sufficient cause of lameness exist higher up the leg, often the foot is also the seat of injury or disease. The foot is tested by compression and percussion, then the shoe is removed, and after clearing loose horn from the sole, frog, and heels, and lightly paring the sole where necessary, the ground surface of the hoof—nail-holes, quarters, heels, and toe—are carefully searched. Failing discovery of any sign of pain, injury, or disease, the shoe may be replaced and the horse run out again. Then the pastern, fetlock, and shank should be manipulated, giving special attention to the sesamoid region and the flexor tendons. If the lameness is in front and the horse is under six years old the cannon should be searched for splint. Next the knee or hock should be palpated, and so on until the limb from the coronet upwards has been carefully examined. As a rule the seat of lameness can be discovered by this method of examination. The first attempt may fail, and in that event, which happens occasionally in slight lameness, the examiner may either prescribe complete rest for the horse and suspend judgment of the case for a day or two, or at once have the horse severely exercised, lunged, or ridden, then rested for half an hour, and repeat the examination. Sometimes difficulty in detecting the seat of lameness may be diminished by resorting to negative diagnosis, that is, by examining and excluding one part after another of the lame leg. This method by limiting the field of discovery is helpful, though it does not tend to confident opinion. Occasionally where some part, though free of evident injury or disease, is peculiarly sensitive to manipulation, a local anæsthetic injected into or immediately above the region may afford useful information by temporarily suspending sensation in and below the area of injection and perhaps removing the lameness. The seat in front lameness is oftenest in the foot or near it, and in hind lameness in the hock. There are rare cases of lameness in which the exciting cause is indefinite, hidden, or beyond reach, but the examiner with patience, assiduity, and well-considered effort should very seldom fail in finding its seat. First views and hasty opinions of lame horses are often erroneous and fraught with danger to the reputation of the practitioner, who should not often accept a conspicuous defect as the actual or only cause of lameness without further examination of the limb. In this connection may be recalled the old, yet useful, warning to the examiner: that swelling over the flexor tendons may coexist with pus formation within the hoof.

The nature of the exciting cause of lameness may have been ascertained in the effort to find its seat. The immediate effects of punctured foot, gathered nail, and other injuries to the sensitive foot are easily recognized, though frequently the extent of the damage cannot be discovered. Pastern and fetlock cases usually require careful palpation, with comparison of the suspected part with the corresponding part of the opposite limb. Tendons and ligaments give less trouble, but sometimes, owing to swelling masking the lesion, diagnosis may have to be deferred. Joints may have to be examined repeatedly before the nature of the lameness can be determined, and the anxious owner of the horse may suggest resort to the X-rays. In lameness affecting the upper region of the fore or hind limb, discovery of the nature and extent of the injury or disease may be very difficult because of the thick muscular covering of the part. Often only a tentative diagnosis can be reached after prolonged examination. In fracture and other injuries of the pelvis rectal exploration should not be neglected.

In this work of arriving at a positive opinion of the nature of the lesion, an intimate knowledge of the normal anatomy of the limbs is extremely useful to the practitioner. He should be familiar with the disposition and relations of the tendons, ligaments, synovial sheaths and bursæ, the bony prominences, the form and mechanism of the joints; the muscles, and their actions in effecting the various movements of the limbs.

Lameness according to the Region affected.—"Shoulder lameness," as commonly employed, is necessarily a comprehensive term, because many of its examples are indefinite as to nature and causation. Wounds, bruises, and other injuries associated with deformity of the shoulder can hardly be mistaken, but cases in which there is no evident surface alteration of the part very rarely admit of positive diagnosis. Atrophy of the shoulder muscles may result from inaction of the limb, and the lesion inducing lameness may be in the foot, fetlock, or at some distance from the shoulder. Fortunately, shoulder lameness is not very common, although frequently lameness of a fore limb is wrongly attributed to this region. The fore limb, unlike the hind one, has no bony connection with the spine, and this to some extent explains the infrequency of shoulder lameness.

The shoulder-joint, formed by the scapula and humerus, has only one ligament, a capsular one, which is well supported by muscles or their tendons. It is a ball and socket joint. The movements of extension and flexion are extensive, but those of abduction, adduction, and rotation are much restricted by muscular attachments. The head of the humerus is furnished with three synovial bursæ which are of importance in connection with shoulder lameness. One of these bursæ facilitates the play of the biceps tendon over the bicipital groove; another is placed between the external tuberosity and the infraspinatus tendon, and the third lies on the inner side between the humerus and the tendon of the subscapularis muscle.

Shoulder lameness may be due to cutaneous wounds, galls, or acne pustules, wounds or bruises of muscles, abscess formation, tumours, myositis, or rheumatism, muscular rupture, atrophy, and cramp; bursitis, fracture (humerus or scapula), wrenched joint, dislocation, open or closed arthritis, ostitis, arterial obstruction, paralysis, and occasionally fistulous withers. In most instances shoulder lameness is shown by restricted movement of the scapula, which appears held to the trunk, the step is shortened, the joint is insufficiently raised, and the foot—apt to catch the ground—is swung outwards or dragged, or it may be carried. Certain forms of shoulder lameness present additional symptoms which may be characteristic and of considerable assistance in diagnosis. In supra-scapular paralysis, and owing to loss of power in certain muscles which support the joint, the point of the shoulder appears to roll or bulge outwards when the foot comes to the ground, and within a few days of the inception of lameness the extensor muscles become plainly atrophied, producing noticeable deformity of the shoulder. In arthritis and in fracture implicating the articular surface of scapula or humerus, the joint, in locomotion, is fixed, the limb is carried, and the patient strongly resents manipulation of the shoulder, which sooner or later becomes enlarged over the joint. Rheumatic shoulder lameness is often intermittent. Under exercise, or while the horse is warm, the action of the limb may gradually improve and lameness may even disappear; but after a rest lameness recurs and it may be aggravated. In walking or trotting, a horse affected with rheumatic myositis may be unable to move forward in a straight line, as happens sometimes in cases involving the mastoido-humeralis muscle. In myositis of the pectoral muscles arising from fatigue, as after a hard day's hunting, the horse is unwilling or unable to trot, and when forced he straddles, flounders, or threatens to fall. Inflammation of the bursa of the biceps tendon (bursitis intertubercularis) is marked, in walking, by inability to advance the foot, though in standing the limb may be used to support weight, and in backing it can be moved without much difficulty. In trotting, the scapula is held forward on the trunk, the shoulder-joint is lowered and fixed, and the foot is dragged. Manipulation of the biceps tendon with passive flexion or extension of the joint appears to cause great pain. This lameness when arising from collision or street accident may be temporarily masked by bruising or painful swelling of the shoulder. Dislocation of the shoulder-joint, which may be complicated by partial fracture of scapula or humerus, or by rupture of ligament or muscle, is distinguished by conspicuous deformity and immobility of the shoulder, and by shortening of the limb which is trailed or carried. The head of the humerus rides on the scapula, and the muscles around the joint are tense or spasmodically contracted. The horse is uneasy, blowing, and sweating.

Shoulder abscess varies considerably in its early manifestation. When the abscess forms in the substance of the levator humeri, beneath it, or in connection with the prepectoral lymphatic glands, the first indication may be stiffness or lameness with diffused swelling of the shoulder extending to the breast and base of the neck. The position of the abscess may be uncertain, but as the abscess matures careful palpation usually discovers a small, very tender area, which when deeply punctured yields pus. Lameness of the arm is met with occasionally. Diagnosis is very difficult except in cases of wounding, or of fracture of the humerus.

Elbow lameness is often remarkable for the excessive nodding or falling of the horse's head. Even when the exciting cause is superficial or trivial this feature may be observed. It has been attributed to limited extension of the joint, which is probably true of some cases of elbow lameness. The elbow is a hinge joint, and its ligaments are two lateral and one anterior or capsular. The joint is closed behind by the synovial membrane, and protected by a portion of the ulna (olecranon), by the extensor muscles of the elbow and the tendons of the five flexors of the knee and foot. Its movements are extension and flexion. Extension is limited by the tension of the lateral ligaments and by the beak of the olecranon, which may be fractured in forced extension of the elbow, an accident which sometimes happens in the recumbent position when a fore foot is secured to a hind limb for operation.

The principal causes of elbow lameness are wounds and bruises, paralysis, fracture, arthritis, and occasionally dislocation and capped elbow. Radial paralysis affects the extensor muscles of the elbow, and the symptoms point to loss of power. The elbow droops, the knee and fetlock are half-flexed, and extension of the elbow and the joints below it cannot be maintained by the horse, though the limb can be thrown forward from the shoulder. In backing the limb is dragged. Radial paralysis is not always a primary affection; it may be symptomatic of hæmoglobinuria. Wounds and bruises of this region frequently lead to open elbow-joint. The wound may not directly penetrate the articulation, in fact it may be an inch or more below it. Small or trivial wounds of the outer side of the elbow may eventually assume a serious aspect by communicating with the joint cavity. Open arthritis of the elbow is attended with few special signs apart from lameness and escape of synovia. The joint may be held slightly flexed, or it may be extended and apparently bearing weight while under treatment. Except in cases due to bruising there is little swelling and seldom systemic disturbance, even when the wound is suppurating. Closed arthritis, which is a slowly progressive disease, is almost confined to very old horses which have done much work. Sometimes both elbow-joints are affected. In trotting, the horse is stiff or lame, the step is shortened and the foot only slightly raised. The front action is crouching, and the lame limb attracts attention by showing a peculiar yielding or leaning movement—the knee not fully extended—when the foot comes to the ground. Dislocation of the elbow is nearly always complicated by rupture of the internal lateral ligament and the chief symptoms are deformity, swelling, and immobility.

Lameness of the forearm is most frequently due to wounding or bruising. Muscular strain is a possible cause, though few cases have been recorded. Punctured and contused wounds of the skin, fasciæ, muscles or, near the knee, their tendon sheaths constitute the bulk of the cases of lameness of this region. The usual symptoms are stiffness or lameness, painful swelling extending beyond the wound or seat of injury, and, in infected cases, fever, loss of appetite, and other signs of constitutional disturbance. Horizontal wounds though shallow are often troublesome to heal. They tend to gape, and sutures seldom retain their position long enough to ensure closure of the wound without pus formation. Punctured wounds, especially in hunting horses, are always dangerous because frequently they lodge a foreign body, a thorn, bit of wire, or wood splinter, etc. Suppuration with extension of infection beneath the fasciæ of the forearm is almost a constant complication. Counter-openings for discharge of pus and disinfection are often necessary, and though generally recovery ensues, sometimes the limb is permanently disfigured. Lacerated and other wounds may heal enclosing a foreign body, unsuspected or overlooked, which leads to recurrent abscess formation and lameness. Such cases are sometimes attributed to fresh injury, the horse having worked since the first wound healed, but repeated suppuration within or close to the area of a cicatrized wound is nearly always due to retention of a foreign body. Contused tendon sheaths, though remaining closed throughout, are apt to assume a chronic character, prolonging lameness and producing permanent distension, which, though unsightly, is unlikely to hinder work.

Lameness of the Knee.—The horse's knee corresponds to the wrist of man. It comprises three transverse joints and a number of vertical articulations. The two principal joints are the radiocarpal, formed between the radius and the upper range of small bones, and the intercarpal, formed between the upper and lower rows of carpal bones. These are hinge joints. The third transverse articulation formed between the lower range of carpal bones and the metacarpus is a simple gliding joint. The bones of the knee are held together by twenty-six ligaments, of which four—two lateral, the posterior and anterior capsular—are common to the whole carpus. The movements of the knee are almost confined to flexion and extension. In flexion very slight abduction, adduction, or even circumduction may be effected, but in extension these movements are prevented by the tension of the lateral ligaments. During flexion the posterior ligament is relaxed, the lateral ligaments are less rigid, and the anterior ligament is quite tense. The stretched condition of the anterior ligament in extreme flexion explains the frequency of open-joint as a complication of broken knee, the ligament being ruptured when the horse falls. Knee lameness may be due to contusion, wounding, wrenching, knee-splint, speedy cut, open or closed arthritis, fracture, ostitis, and thoroughpin. Wounds and bruises of the knee give little difficulty in diagnosis. Wrenched knee is always associated with painful swelling of the joint. Fracture of one of the small bones may not be discovered during life. Knee-splint may be confounded with arthritis or Cherry's disease. Thoroughpin which affects the synovial sheath of the carpal arch, through which run the flexor tendons, is easily recognized. In most painful conditions of the knee, flexion of the joint is restricted and the knee is raised very little. In acute carpitis the foot, in trotting, is thrown outwards, and the knee is very slightly bent. The step of the lame limb is lengthened, and the shoe is worn at the heels. Flexion of the knee is exceedingly painful in thoroughpin, in which the leg may be abducted and carried in forward movement. Knee lameness not due to visible injury may be diagnosed by watching the action of the limb and by careful palpation of the joint. Carpitis or synovitis of young horses is often associated with swelling and palpably increased heat of the affected knee. "Capped knee," which is a familiar example of contusion, varies greatly in degree. This injury may be contracted in the stable by the horse striking the knee against the manger, or on the street through the horse falling. Swelling, due to serous effusion, and sometimes blood extravasation, forms in front of the knee, and, depending on the severity of injury, the limb above and below the joint may be œdematous. In some cases the effusion accumulates beneath the skin, but often it lies between the fasciæ and the annular ligament. At first the swelling fluctuates, but later, owing to partial absorption of the fluid and to changes in the skin and fasciæ, it is firmer and more resistant. The knee is stiff, painful to manipulation, and lameness may be insignificant or prominent. Capped knee, though seldom interfering with the horse's usefulness, is unsightly and liable to result in permanent deformity of the front of the joint.

"Broken knee" is the term applied to wounding of the front of the knee. It may be a simple abrasion of the skin, or a contused, lacerated, or other wound penetrating the skin and fascial layers, a tendon sheath, or even one of the carpal joints. Usually the injury is contracted by the horse coming down on his knees, but occasionally it may result from his failure in jumping to clear a wall or fence. At the first examination of a case the practitioner may have difficulty in forming an accurate estimate of the extent of injury. Wounds small at the surface may communicate with a joint, and large wounds exposing some of the small bones, though very alarming, may be far less serious. Synovia may escape from a tendon-sheath or a joint, but its source is of minor importance. Infection is the chief danger of broken knee. Superficial and contused wounds, even when complicated by sloughing or loss of tissue, usually heal more or less satisfactorily, though frequently they leave scars, indurated skin, and other blemishes which depreciate the market value of the horse. Deep or penetrating wounds often result in permanent stiffness of the knee, and a horse with a stiff knee is seldom workable. Open knee-joint or tendon-sheath is hopeful so long as the discharge is free of pus, and even the infected case, though less promising, is not always hopeless. Persistent suppurative arthritis usually terminates in anchylosis of one of the principal joints of the knee, but frequently long before this result has been reached, and in consequence of emaciation, weakness, or exhaustion of the patient, slaughter is advisable.

Lameness of the Cannon.—Splints, sore shins, strains of the flexor tendons, subcarpal and suspensory ligaments, wounds, bruises, and fractures are the chief causes of lameness of this region. The action of the lame limb, except in a few cases of splint, flexor strain, and fracture, affords little or no assistance in diagnosing the seat of lameness. Strain of the perforatus is accompanied by deformity of the posterior border of the shank, but in strain of the perforans, subcarpal and suspensory ligaments, though swelling may be seen, diagnosis can only be made by careful palpation of the tendon or ligament. In severe perforans or subcarpal strain the horse may "go on his toe" with the heel raised, but in many instances of moderate strain the tread of the foot is unaltered. In some cases of splint lameness the action of the limb is stilty and suggestive of severe injury or fracture.

Fetlock Lameness.—The fetlock joint is formed by the large metacarpal or cannon, the long pastern, and sesamoid bones. It has ten ligaments arranged in two sets: four attaching the cannon to the pastern and sesamoids, and six binding the sesamoids to the pastern. The single synovial membrane is protected in front and at the sides by the anterior capsular and lateral ligaments, but behind it is free, forming a prolongation, which lies in front of the divisions of the suspensory ligament, and which when dilated constitutes articular windgall. The fetlock is supported in front by the extensor tendons of the foot and pastern, behind by the flexor tendons which play over the sesamoid pulley, and the whole joint is surrounded by an aponeurosis which serves as a strong fibrous brace to the flexor tendons and sesamoids. The movements of the joint are flexion and extension, with very limited lateral motion during flexion. The flexibility of the fetlock is influenced by breeding and by the conformation of the limb. In horses with long, sloping pasterns, full extension is very similar to flexion, and in action the play of the joint is spring-like and pliant. The resiliency of the fetlock probably accounts for its comparative freedom from the effects of strain and concussion to which by its position it is much exposed.

Fetlock lameness may be due to strain of tendon, suspensory or other ligament, sesamoiditis, fracture, rupture, arthritis, bursitis, wounds and bruises (striking, cutting, or brushing). In most instances swelling or other surface alteration attracts attention to the joint, and in cases of rupture, severe strain, or fracture the carriage of the fetlock in progression is suggestive if not diagnostic of the seat of lameness. Frequently the nature of the exciting cause can only be ascertained by palpation, and by resorting to passive movement of the joint. Knuckling is apt to mislead the examiner, for often this deformity has no immediate connection with the fetlock. Sinking of the fetlock may be due to rupture of the flexor tendons, the suspensory or the subcarpal ligament, or the above-mentioned aponeurosis. Rupture of the perforans below the point where it is joined by the subcarpal ligament is followed at once by more or less sinking of the fetlock and elevation of the toe. In rupture of either the suspensory or perforatus alone the fetlock sinks very little and the toe is not elevated, and in perforatus rupture the fetlock may be slightly overshot. When the fetlock rests on the ground both flexors and the suspensory have given way, and sometimes this rupture is complicated by fracture of the sesamoid bones. Obvious yielding of the fetlock accompanies rupture of the aponeurosis even when the flexors and suspensory are not implicated.

Intermittent lameness with varying local surface heat is characteristic of inflamed sesamoid sheath, a condition which may be confounded with navicular disease. Ostitis of the sesamoid is nearly always associated with palpable enlargement of one or both bones and persistent slight lameness. Fetlock lameness increasing in degree from day to day is usually due to abscess formation or infected puncture of the joint. Painful (or painless) swelling in front of the fore fetlock is most often due to injury or chronic distension of the synovial bursa of the extensor pedis tendon. The bursa of the extensor suffraginis tendon is seldom affected. Windgalls, articular or tendinous, cause lameness when bruised and also when their distension is large enough to hinder free movement of the joint. Tendinous windgall of the hind fetlock, in consequence of injury producing chronic inflammation, thickening and induration of the sheath, may cause permanent lameness with obstinate knuckling, the horse "going on the toe" as in acute bone-spavin disease.

Lameness of the Pastern and Foot.—The pastern or coronary joint is formed by the os suffraginis and os coronæ, or the long and short pastern bones. These are held in position by three ligaments: two lateral, one on each side, and a posterior, which is represented by the glenoid fibro-cartilage and its attaching bands. Each lateral ligament after its attachment to the os coronæ is prolonged downwards to the corresponding extremity of the navicular bone to form the posterior lateral ligament of the coffin joint. The glenoid fibro-cartilage, which extends the articular surface of the os coronæ posteriorly, is attached to the os suffraginis by six short, fibrous bands. Its posterior surface is polished to facilitate the gliding of the perforans tendon, for which the fibro-cartilage serves as a fixed sesamoid. In front, the coronary joint is protected by the extensor pedis tendon, which is expanded and continuous by its borders with the lateral ligaments, and behind, it is supported by the perforans. The perforatus tendon, between its attachment to the radial ligament at the knee and its fixed insertion on the os coronæ, plays the part of a suspensory or supporting ligament to the coronary joint. The joint is hinge-like, and its movements are flexion and extension, with slight lateral motion during flexion. The whole joint is enclosed by a single synovial membrane which forms on the posterior surface of the os suffraginis, a prolongation which occasionally is distended in racehorses.

The pedal or coffin joint, which is completely concealed by the hoof, is formed by the os coronæ or short pastern, os pedis or coffin bone, and the navicular. It is a hinge joint of very limited mobility. The bones are held together by five ligaments: four lateral, two on each side, and an interosseous, which binds the navicular to the os pedis. This joint is strengthened by the extensor pedis and flexor pedis perforans tendons, which expand as they descend to their fixed insertions on the coffin bone, and by the lateral cartilages with their attachments to the bones. The posterior-lateral ligaments at their insertion on the navicular bone concur in forming a fibrous cushion which extends the gliding surface of the sesamoid for the perforans tendon. The single synovial membrane which encloses the joint forms between the lateral ligaments a small dilatation which is sometimes accidentally opened in the operation for necrosis of the lateral cartilage.

Lameness of the Pastern and Foot.—While pastern lameness is almost confined to ringbone, fractures, wounds, bruises, and cracked heels, foot lameness arises from many different causes, of which the more common are corn, quittor, bruised coronet, sand-crack, seedy-toe, laminitis, navicular disease, canker, horn tumour, gathered nail, injuries contracted in shoeing, and defects of the hoof.

Pastern lameness, save in a few instances, is not easily distinguished from lameness of the foot. When the pastern presents a wound, bruise, or other obvious injury, lameness may be attributed provisionally to the visible lesion, though frequently another and more important cause may exist elsewhere in the same limb. Fissured or split pastern may be suspected from the history of the case, but until swelling and other local symptoms appear diagnosis may be uncertain. Lameness arising from ringbone may not be particularly different from lameness caused by a lesion existing immediately above or below the pastern. In chronic articular ringbone the gait of the affected limb is modified, the coronary joint is enlarged and fixed, and the shoe appears excessively worn at either its toe or heels. Cab-horse disease, a variety of ringbone, is always accompanied by enlargement of the inner head of the long pastern bone. Pyramidal disease or ringbone of the os pedis produces deformity of the hoof, the toe-wall presenting a ridge or convexity moulded on the outgrowth of the coffin bone, and in the trot the action of the foot resembles that of chronic laminitis, with which pyramidal disease may be confounded. In the hind foot, pyramidal disease may easily be mistaken for "buttress foot," a condition resulting from fracture of the os pedis. Lameness of both fore feet due to corns may be mistaken for chronic navicular disease; but in the former, exercise induces no marked improvement in the horse's action, while in the latter, exercise either diminishes or temporarily removes the lameness. When corns and navicular disease coexist, exercise has little or no influence on the horse's action, and more or less lameness persists in spite of successful treatment of the bruised heels. Chronic navicular disease of both fore feet may sometimes be confidently diagnosed by watching the horse moving at different paces. In intermittent slight front lameness incipient navicular disease may be suspected, but diagnosis is always attended with difficulty, and frequently doubt remains after the use of a local anæsthetic has reduced the area of the exciting cause of lameness to the foot. In all cases of obscure front lameness the form of the foot should be carefully considered and compared with that of the sound one. The fore feet may be odd or unequal in size, and though frequently the smaller foot is the seat of disease, the examiner should remember that the inequality may be congenital, or possibly the result of accident during foalhood temporarily preventing full use of the limb. Commencing seedy-toe can only be discovered after removal of the shoe. Extensive seedy-toe produces deformity of the hoof and alters the tread of the foot. The toe may be tilted at each step, a symptom which is also shown in painful toe sand-crack and horn tumour of the wall of the hoof. Lameness arising from uncomplicated quarter sand-crack has no peculiar feature, but in open or overlapping sand-crack with infection of the exposed laminæ the tread of the foot is eased on the painful side. Acute laminitis of the fore feet can hardly be mistaken for any other cause of lameness, though diagnosis may be hesitating at the onset of the attack. Chronic laminitis is usually associated with deformity of the hoof, particularly of the toe-wall and sole. This lameness may sometimes be diagnosed at a distance from the horse "going on his heels," but as a rule close inspection of the feet is desirable. Canker may be discovered by its offensive smell. The advent of lameness or its aggravation in canker is often coincident with the beginning of curative treatment. In many acutely painful conditions of the foot (suppurating toe sand-crack, abscess formation, fracture, bruised coronet, etc.) the limb is carried or very carefully used in progression. A horse may "go on the toe" in painful toe sand-crack of a *hind* foot. The degree of lameness arising from gathered nail depends on the position and depth of puncture or the structures penetrated. Infection of the wound always aggravates the lameness. Fractured navicular bone, even when unaccompanied by external lesion, produces great lameness, and often the patient refuses to use the foot in standing or walking. A foreign body—splinter, wire, or thorn—which has entered the coffin joint from the coronet may give no external indication of its presence other than persistent severe lameness. In this and similar cases resort may be had with advantage to the X-rays, though it must be said that skiagraphs of fractures without displacement and of inflamed joints are not very helpful in diagnosis.

Lameness of the Hind-quarter or Hip.—At the croup the pelvis on each side articulates with the spine, forming the sacro-iliac joint, which has very limited movement, though probably its slight mobility assists in diminishing the effects of concussion. The hip-joint, formed by the pelvis and femur, is similar to the shoulder-joint, but it has three ligaments and the globular head of the femur is closely embraced by the cup-like articular cavity of the pelvic bone. It is a ball-and-socket joint, and its movements are flexion and extension with abduction, adduction, and circumduction.

Lameness of the haunch or croup may result from casting a horse for operation or from the horse struggling when down in a stall or loose-box. In draught horses it is often due to a heavy weight (scaffold pole, truss of hay, iron pipe or beam) falling from a height on the croup. The symptoms vary from stiffness of the hind-quarters to severe lameness with drooping of the pelvis and a straddling gait. There may be little or no swelling in the region of the sacro-iliac joint, but usually the horse evinces great pain on palpation of the croup, which sinks under very light pressure. The action of one or both hind limbs may resemble that shown in partial motor paralysis and in fracture of the iliac brim. In five or six days after the accident atrophy of the muscles of the croup, extending to the loins, will be evident. Cases uncomplicated by fracture eventually recover, though difficulty in backing a load may remain for many months and the atrophied muscles may never regain their normal volume.

Hip lameness when not due to fracture of the pelvis is oftenest caused by bruising or wounding and only occasionally by strain, wrenching, or arthritis. Dislocation of the hip-joint and lameness involving the teres ligament are extremely rare, but in towns, and mainly owing to horses falling on the streets, inflammation of the bursa of the middle tendon of the gluteus maximus is not uncommon, and sometimes this lesion is associated with ostitis of the trochanter major of the femur. Rheumatic myositis of the gluteal or other muscles of the quarter may be met with at long intervals, but gluteal paralysis is seldom a primary cause of lameness.

Lameness of the hip, like that of the shoulder, is easily recognized, though frequently, and mainly owing to the thick muscular covering of this region, the nature of the exciting cause cannot be discovered. An acute observer may be baffled in diagnosing the seat of slight hip lameness. Fortunately, cases of slight hip lameness often recover rapidly and sometimes before treatment has been applied. In severe hip lameness rectal exploration is generally advisable: it removes doubt when it does not confirm suspicion. Some authorities state that hip lameness may be distinguished by "a hop and a catch" in the movement of the lame limb, but this or a like peculiarity of action is more often connected with superficial injury to the stifle. In most cases of hip lameness the quarter on the lame side is carried high, the step is shortened, and the limb, more or less dragged, may be adducted or abducted, or even swung outwards. Movement of the hip in walking, trotting, and turning is notably restricted. In teres or hip-joint lameness the horse moves diagonally or away from the lame side, the limb is adducted, and in harness work the shaft next the sound side shows the effects of constant contact with the limb. In bursitis the limb is abducted, the quarter elevated, and painful swelling may exist over the convexity of the trochanter major of the femur. Abduction of the limb is a feature of obturator paralysis, which, when arising from fracture, may be diagnosed by rectal exploration. Certain pelvic fractures with impaction or displacement of the fractured parts and consequent noticeable deformity of the quarter (angle of the haunch, tuber ischii, iliac and ischial shafts) may be located at the first inspection of the case, while others require careful examination of the pelvis internally as well as externally before the position and extent of the injury can be discovered.

Lameness of the thigh is often referred to the quarter for the reason that the seat of the lesion may be very difficult to find. In some cases, however, the cause is obvious. Thigh lameness with marked abduction of the limb may be due to tumour formation, abscess, large scirrhous cord, acute hydrocele, orchitis or mammitis, and inflamed scrotal hernia. Other causes are paralysis, fractured femur, wounds and bruises of the muscles of the thigh. Crural paralysis may be a primary affection or it may be symptomatic of hæmo-albuminuria, and however arising, its principal symptom is loss of power in the extensor muscles of the stifle, which sinks at every attempt at extension in the same way as the elbow in radial paralysis. When connected with hæmo-albuminuria, crural paralysis always leads to atrophy of the affected muscles. Drooping of the thigh and stifle is also seen in fractured patella and external popliteal paralysis, conditions which hinder flexion of the hock while they favour flexion of the fetlock and dragging of the toe.

Stifle Lameness.—The horse's stifle, which corresponds to the human knee, comprises two joints: one formed by the patella or knee-pan with the femoral trochlea, the other by the head of the tibia with the condyles of the femur. The first is a gliding joint, and in action the patella moves on the femoral trochlea, or with equal accuracy it may be said that the trochlea moves on the patella, which plays the part of a sesamoid bone. The patella, suspended by the extensor muscles of the stifle, is attached to the tibia by three strong fibrous cords and to the upper and lateral borders of the trochlea by the capsular ligament, which is strengthened laterally by two fibrous bands. It is also held in place by the tensor of the fascia of the thigh and by certain other muscular connections. The second, or femoro-tibial, is a hinge joint. It is peculiar in having interposed between the articular surfaces two crescent-shaped fibro-cartilages which participate in its movements—flexion, extension, and rotation. This joint has a capsular and two strong lateral ligaments with two fibrous bands (interosseous ligaments) connecting the bones within the articulation, and it is furnished with two synovial membranes, which sometimes communicate with the single synovial membrane of the femoro-patellar joint—a fact of some importance in connection with the treatment of hydrops and of penetrating wounds of the stifle. The existence of a mucous bursa which lies on the upper half of the anterior surface of the patella should also be remembered in the diagnosis and treatment of stifle injuries.

Stifle lameness may be recognized by watching the horse's gait. The quarter on the lame side is carried nearly level or very slightly elevated when the foot comes to the ground. The step is shortened, and usually there is evident deformity of the front of the stifle. In fractured patella the stifle droops, extension is defective, the fetlock is flexed, and the toe scrapes the ground. Wounds and bruises of the stifle nearly always implicate the patellar bursa, which when distended constitutes capped stifle—a very similar condition to ordinary capped hock. A blow without skin abrasion over the patella is often followed by severe lameness, and frequently in cases of trivial wounding or mild contusion, the degree of lameness exhibited by the horse is much greater than the character of the injury would appear to justify. Deforming arthritis may affect either joint of the stifle. In femoro-tibial disease the horse at first shows only slight intermittent lameness, with a tendency at every opportunity to ease the leg by semiflexing the stifle, hock, and fetlock, the foot resting on the toe with the heel raised. Later, lameness is continuous, and when standing the horse holds the foot raised from the ground, flexing the stifle, hock, and fetlock. The surface depression normally existing below the patella at the front of the joint is now effaced, the stifle appears broader and more prominent, yet manipulation usually fails to discover enlargement or exostosis of the femoral condyles or the tibial facets. In femoro-patellar disease, from the beginning lameness is constant and much more noticeable than in that just mentioned. At rest the horse uses the limb to support weight, the extended stifle appears deformed, while enlargement of the borders of the trochlea and patella may be discovered by manipulation. Dropsy of the stifle usually affects the femoro-patellar joint of one or both limbs. Lameness may be slight, but in most cases the limb is dragged. Deformity of the patellar region produced by distension of the joint capsule attracts attention to the stifle. Luxation of the patella may be outwards or upwards on the femur. In upward luxation the limb is held extended with the stifle and hock rigid, and in movement the toe is elevated, with the heel in contact with the ground. In outward luxation the stifle is fixed, the limb projected backwards with the foot resting on the toe-wall. Horses with straight stifles and weak extensor muscles are particularly liable to recurrent outward luxation of the patella, but in these the backward projection of the limb is limited and reduction of luxation is often spontaneously effected. In subluxation or momentary arrest of the patella on the femoral trochlea, flexion of the stifle, hock, and fetlock is suddenly interrupted, the limb is extended and slightly abducted, and in the effort following the pause, which seldom lasts many seconds, the patella moves, the hock is sharply flexed, the foot rising as in stringhalt. Subluxation has been called "straw-cramp." It frequently affects horses—often ponies—standing in loose-boxes, and the movement suggests muscular spasm. The same or a very closely allied condition may be seen in debilitated animals, worm-infested colts and fillies after a run on poor pasture, and in horses approaching convalescence from influenza and acute respiratory disease.

Lameness of the lower thigh or leg, excepting paralysis and so-called rupture of the tendinous flexor metatarsi, presents no peculiarity of action that is of much service in diagnosis. Wounds and bruises causing lameness are easily seen, and fracture of the tibia may be suspected when the wound or bruise is on the inner side of the lower third of the leg. In fracture, frequently the wound appears trivial, with slight œdema extending above and below the point of injury. Displacement of the fractured parts does not take place for some time, and in many instances not at all. Lameness varies from stiffness or slight lameness to carrying the leg. The fracture may split the bone in two or three directions from the point of injury, or it may be limited to fissuring of its inner wall. Often the horse is kept at work until the leg gives way, a result which may be avoided by resting the horse—tied up or in slings—for three weeks after the accident. It has been supposed that the fascia which closely invests the bone hinders separation of the fractured parts, though more probably the true explanation of the delay may be found by assuming that the immediate effect of the blow or kick is a "star fracture"—that is, a centre corresponding to the point of impact with fissures of varying length and depth radiating from it—and that when the horse is rested sufficiently to permit of union neither extension of the fracture nor its separation takes place.

The carriage of the limb in flexor metatarsi lameness is strongly suggestive of loss of power in the flexor of the hock. In progression the limb from the stifle downwards is lifted and advanced without hock flexion, and the unapposed tendo Achillis is lax enough to appear flaccid. External popliteal paralysis interferes with the action of the stifle, hock, and fetlock, and the tread of the foot. In forward movement the limb is dragged, the front of the pastern and foot grazing the ground, but in backing the horse, the foot is used to support weight, the heels resting on the ground. Passive flexion of the hock is very difficult if not impossible.

Lameness of the Hock and Shank.—Many lamenesses are connected with the horse's hock, which corresponds to the ankle in man. The bones are arranged in two rows: the upper of two (astragalus and os calcis), the lower of four bones (cuboid, scaphoid, and two cuneiform). They form with one another, and with the tibia above and metatarsus below, five articulations, of which the principal and most important in movement is that formed by the tibia and astragalus. It is a hinge joint; its movements are flexion and extension, and the two bones are held together by seven ligaments—three internal and two external lateral, with two capsular which close the joint in front and behind. The synovial membrane communicates with that of the joint immediately below the astragalus, and its distension constitutes the condition called bog spavin. The other or subsidiary joints of the hock have extremely limited motion, but the articulations of the lower bones with one another and with the metatarsus are important, because they are often implicated in bone-spavin disease.

The common causes of hock lameness are bone spavin, sprained or wrenched hock, curb, synovitis, arthritis, wounds and bruises. Fractures or dislocations of the bones and luxation of the perforatus tendon are extremely rare. The term spavin is often misunderstood. It has an evil reputation which horse-owners not infrequently apply to many different forms of hock disease. Bone spavin is an ostitis with a bony outgrowth ("jack or spavin") at the seat of disease. Occult spavin is an ostitis and ulcerative arthritis, terminating in fusion of the affected bones but producing no appreciable enlargement or bony outgrowth ("jack or spavin"). Chronic bog spavin is a painless distension of the anterior capsule of the true hock joint, and blood spavin—a harmless condition—is a dilated or prominent vein which crosses the hock close to the seat of bone spavin.

Bog spavin and thoroughpin seldom cause lameness except when the distension is excessive or has been bruised. Very large bog spavin by hindering free movement of the hock joint may induce stiffness or even lameness, but in such case the cause is evident. In active bone-spavin disease with enlargement the horse in trotting carries the quarter low on the lame side; at each step the hip appears to sink momentarily when the foot comes to the ground, the stride is shortened, the toe dragged, and there is restricted flexion of the hock. Lameness is most conspicuous when the horse leaves the stable after a rest. Usually while the horse is at exercise lameness diminishes or temporarily disappears, recurring after a brief rest. But in occult spavin and other forms of tarsal arthritis there is no remission of lameness, which on the contrary may be aggravated by exercising the horse. In bone-spavin lameness restricted hock flexion is not due to disease or implication of the principal joint, but to the painful effects of free movement and compression or concussion on the inflamed or spavined bones.

Sprained or wrenched hock is always accompanied by painful swelling or distension of the true hock joint, which is not flexed even in slow movement of the horse, and in trotting the limb is carried.

Curb is a prominence or limited thickening, arising from strain, of the calcaneo-metatarsal ligament, which binds the os calcis to the cuboid and external metatarsal bones. The lesion is visible, firm and fairly well defined in most cases, forming a bulge on the otherwise straight, posterior line of the hock. Small curb, and even large curb, frequently exists without lameness, though slight lameness may be noticeable for a day or two immediately after the accident. Diffused or extensive curb arising from severe or repeated strain may be attended with persistent lameness which cannot be easily removed. The action of the lame limb has no distinguishing peculiarity, although in trotting the horse may go "on the toe" and in standing elevate the heel. Curb may be confused with "false curb" and with "curby hock." In some horses with well-formed limbs the head of the external metatarsal or splint bone is exceptionally large or prominent, the increase in size producing a nodular enlargement or "false curb." Similar enlargement of the head of both small metatarsal bones may be seen in "curby hock," which can be readily recognized by observing the position of the head of the os calcis, which instead of being upright is inclined forwards, and by the unbroken curvature of the posterior border of the limb. Hind limbs of faulty conformation, and particularly sickle-shaped hocks, are said to be predisposed to curb, but in wear such limbs may never show this lesion, while straight hocks and those of excellent formation are often affected. The tendency to curb is favoured not only by conformation of limb but also by the work, age, and temperament of the horse. Nervous or excitable young animals and those of high courage or playfulness are the chief subjects of curb.

The lamenesses of the hind limb below the hock are similar to those of the fore limb below the knee, but of the many diseases which affect the fore cannon, pastern, and foot only a few are met with in the hind limb. Strain of the flexor perforans tendon or of its check ligament is common in draught horses. Lameness of the hind shank in aged horses is often due to splint which forms on the outer side of the upper third of the bone. In neither case is the action of the limb peculiar or of much assistance in diagnosis. Injuries to the fetlock and foot are more common in the hind than in the fore limb, but navicular disease, sidebone, and corn are rarely found in the hind feet.

Defective action or lameness of one or both hind limbs, including paralysis, shivering, and stringhalt, arising from spinal lesions, nerve derangement, or vascular obstruction, will be described later (see pp. 725-35).

General Treatment of Lameness.—The exciting causes of lameness vary greatly in nature and severity, and although each case should be treated according to its particular requirements, there are certain curative measures which can be applied more or less satisfactorily in all cases. Wounds and bruises causing lameness may be dealt with by the methods detailed under "Accidental Wounds and their Treatment" (pp. 559-95). After healing of a wound or bruise lameness may continue, owing to the effects of the injury (formation of adventitious fibrous tissue, or bony outgrowth) interfering with function, as the movement of a joint, the play of a tendon or ligament, or with muscular action. Acute or chronic inflammation, however arising, of bone, ligament, tendon, muscle, joint, nerve, or synovial membrane, is the predominant cause of lameness, and in most cases treatment must be directed to arresting or modifying the inflammatory process. The age of the patient, duration of lameness, the position and nature of the lesion or exciting cause, should be considered before treatment is commenced.

In all cases attention should be given to the horse's feet and shoes. Removal of one or all four shoes may be desirable, and in some cases the shoe must be removed to facilitate examination and treatment of the lame foot. But removal of shoes is not advisable in every case, even when the feet are sound, for in standing without shoes the hoofs are soon broken and the sensitive foot may be bruised. Weak, flat feet with thin heels should not be left unprotected for many days, and if the horse must rest for several weeks he should be re-shod with light, plain shoes of fair breadth of web, or with bar shoes. Lameness caused by corn, seedy-toe, or sand-crack usually requires immediate alteration of the shoe. Lameness due to acute strain of perforans tendon or subcarpal ligament, spavin disease, curb, or wrenched fetlock, with constant elevation of the heel, is benefited by a thick-heeled, calkined, or even a patten-shoe. Raising the heels of the shoe affords relief by supporting the hinder part of the foot and easing tension of the flexor tendons. In perforatus strain a high-heeled shoe is not advisable, as it tends to induce knuckling at the fetlock. (See also "Surgical Shoeing," pp. 1099-1106.)

Rest is one of the most valuable aids to the successful treatment of lame horses. For many it is imperative, for the majority it is beneficial, and for all it is desirable though not always advisable. Lameness in foals, yearlings, and young stock generally, and especially when the nature of the cause is obscure, is often removed by rest alone. For lameness in growing animals, rest, prolonged rest in loose-box, straw-yard, or paddock, is often preferable to lotions, liniments, or blisters, which frequently only irritate the wrong place and, even when correctly applied, have only a superficial and transient effect, while further applications may be hindered or prevented by the condition of the skin or by some unexpected accident or complication. Impartially considered, this sort of treatment is without advantage, for apart from the period of skin irritation the patient has been actually resting. Older horses, animals which are amenable to handling and the necessary restraint, and which have reached maturity of structural development, may be given assistance when lame, but even those animals frequently regain soundness of action within a reasonable time under rest and without interference by treatment of the lame part. Further restriction of movement in lameness can be obtained by slinging the horse, a practice that is less popular now than formerly even in the treatment of fractures. Slinging a patient affected with severely painful lameness, as acute laminitis, cannot be commended, because it is more likely to aggravate than mitigate the animal's suffering. In certain lamenesses local rest can be obtained by resorting to splints, plaster or starch bandages, a charge, or a pitch plaster.

Warm fomentations are often beneficial in painful lameness, and in any case they are seldom harmful, but the employment of hot water in a satisfactory manner is frequently attended with inconvenience. To succeed, warm fomentations should be frequently repeated at short intervals or continued for several hours, and afterwards the injured part should be swathed in flannel, blanket, spongio-piline, or other compress—wrung out of hot water—and covered with rubber sheeting to prevent evaporation and too rapid loss of heat. Hot fomentations, by dilating the vessels at the periphery of the injured part, relax the tissues, ease pain, and promote rest. They are specially indicated in cases of wrenched joint, severe contusion, and muscular sprain. When infection of the part is doubtful, a non-irritating antiseptic should be added to the water.

Poultices of bran and linseed meal, spent hops, oatmeal, pulped roots or other materials, though contra-indicated as applications to wounds, are still useful in diseases of the feet to cleanse and soften the horn prior to exploration of the foot. Poultices, medicated or mixed with disinfectants or deodorants, may be employed in the early treatment of thrush and canker. Immersing the foot for a time in hot water is an excellent substitute for a poultice, but at best an inconvenient one. Compresses of flannel, layers of cotton-wool, or calico folded several times and thoroughly saturated with hot water may be used in lieu of poultices for some cases. When it is necessary, prior to further treatment, to soften and remove crusts or scurf and cleanse a part, as in some cases of cracked heels, a medicated compress or an oatmeal poultice will be found very effective. Antiseptic compresses, hot or cold, are sometimes desirable after operations to limit consecutive œdema and to support the sutured wound.

Lotions and liniments are often employed in the early stages of lameness. Caution is required in applying liniments to inflamed parts, for often they are used at the wrong time when they aggravate the mischief they are intended to repress. Slight temporary lameness is often prolonged by the erroneous application of some domestic or vaunted "cure-all" liniment, which frequently by its irritant effects disguises the nature of the primary injury and retards progress towards recovery. But when employed intelligently liniments often render considerable service in the treatment of temporary lameness. Stimulating embrocations of turpentine, solution of ammonia and oil, of soap liniment, or of compound camphor liniment may be applied to the unbroken skin in certain cases of lameness arising from slight bruising or strain of muscle, but care is necessary in applying oil of turpentine to the horse's skin, which appears to be especially susceptible to its action; the surface of application should not be extensive, or the horse may become very restless or unmanageable.

Cold in the form of douching, spraying, or continuous irrigation with cold water, ice poultice, or evaporating lotion is often valuable in the initial stage of inflamed tendon, joint, or muscle. After blistering, firing, or other severe treatment, douching the part with cold water for fifteen minutes two or three times a day removes congestion and swelling, contracts the skin vessels, braces the tissues and promotes recovery. Recent sprains are much benefited and readily prepared for more active measures by refrigerant lotions of methylated spirit and water, solution of ammonium chloride, lead acetate, or Epsom salt, or by shot compresses, or Leiter's tubes through which ice-cold water continuously runs.

Massage, kneading, or hand-rubbing, when properly carried out, is very useful after subsidence of the more acute or painful local symptoms of tendon sprains. Hand-rubbing is often practised in limb cases and generally in a downward direction, but a better result would follow rubbing or kneading the injured part upwards or in the direction of the venous blood stream. Usually it is desirable, in order to induce effort in the masseur, to prescribe a bland oil to be well rubbed into the swollen joint or tendon. By this method it has been said that the effects of recent sprains of tendons have been completely removed and the lame horses made sound.

Pressure bandages have a very limited application in the treatment of lameness. Carefully applied within a few hours of the occurrence of tendon sprain, they restrict swelling and exudation and promote resorption of extravasated blood. Pressure bandages consist of a thick layer of cotton-wool disposed evenly over the injured tendon and secured in position by a linen or, preferably, a rubber bandage. They should not be removed for several days unless they become displaced, in which event they should be immediately adjusted or reapplied. After ten to fifteen days they may be discontinued and replaced by bandages saturated with cold water or astringent lotion preparatory to further treatment of the part by blistering or firing.

Scarification or local bleeding is sometimes advantageous in the treatment of bruised coronet and other parts of the fore or hind limb. Many cases of bruising, particularly of joints, indicate early scarification as a useful remedy, but owing to the risk of infection of the punctures discrimination is required in resorting to this method of relieving pain. In some cases a full dose of purgative medicine, acting as a derivative, may with advantage take the place of local bleeding.

Counter-irritation by blistering, setoning, or firing the skin over the injured part is often employed after the more acute local symptoms have disappeared. Although the mode of action of counter-irritants has not been satisfactorily explained, experience of their effects tends to show that they are frequently indispensable to the successful treatment of lameness. By rest alone a lame horse may be restored to soundness of action, and he may continue sound or he may fall lame again on resuming work. In most cases of lameness the result is uncertain, and in order to secure if possible a useful recovery some form of counter-irritation is generally necessary or advisable. But too much should not be expected from either blistering or firing ; neither is a certain cure for every lameness, but conjoined they constitute the most effectual remedy for many cases of chronic lameness due to disease of bones or joints. Nothing can be gained by firing a sidebone or an established ringbone ; the ossified lateral cartilage is beyond repair, and firing has no influence for good on the joint already fixed by anchylosis. Firing a splint, a spavin, or a ringbone in process of formation may and often does effect improvement by arresting the process, hastening its completion, or by consolidating the new growth already formed and diminishing its prominence. Blistering alone, even when repeated at short intervals, is less effective than firing followed by blistering, though it does not blemish the skin as firing in lines is sure to do. Firing in points, the cautery penetrating the lesion, is more serviceable than line firing, which, while the inflammation continues, is said to have a bracing influence on the skin.

Setons, properly employed, maintain their irritant effects much longer than firing, and in certain cases they are preferable to other forms of counter-irritation, though they are often objected to on account of the pus-formation which attends their use.

Neurectomy, which has been described as the last resort of the baffled practitioner, is often quite useful in the treatment of chronic lameness of the lower parts of the fore or hind limb after counter-irritation has failed as a remedy. Chronic lameness arising from navicular disease, ringbone, or exostosis of the fetlock can be removed by resection of nerves, and in suitable cases this operation should be performed without hesitation or delay. As a rule, lameness which indicates the advisability of neurectomy is not removable by any other means. Although neurectomy is not free from risk of accident (sloughing of hoof, tendon rupture, fracture, etc.) as a consequence of the operation, the failures seldom exceed five per hundred, a proportion which hardly amounts to a deterrent.

Tenotomy is a useful operation in selected cases of chronic knuckling at the fetlock, spavin disease, and continuous stringhalt, but the result cannot be foretold. Flexor tenotomy is only advisable when the horse-owner is willing to rest the animal long enough to permit of complete consolidation of the replacing fibrous tissue at the seat of section—a period of from six to nine months. Cunean tenotomy is a doubtful remedy for spavin lameness, though sometimes the result is fairly satisfactory. Peroneal tenotomy is always worth trying for the relief of well-marked stringhalt, and if it fail to remove the defect it is otherwise a harmless operation.

Lame horses should be suitably fed and clothed, and walking exercise should be prescribed when desirable. Their diet should be simple and laxative. Lame horses should be allowed freedom to lie down so long as they can rise without assistance. J. M.

LAMENESS ARISING FROM DISEASES OF BONES AND JOINTS

Inflammation of the Shoulder-joint.—This is a rare condition, as the joint is well protected from injury by its muscular covering. Injury to the capsular ligament, however, may arise from excessive abduction, adduction or rotation. Rheumatism may be responsible in a few cases. Chronic cases of arthritis in this joint are usually accompanied by considerable exostosis. Joint ill in the foal may affect the shoulder.

The symptoms are those of shoulder lameness, and diagnosis is difficult in the early stages, particularly as the bursa of the biceps may be involved simultaneously. When exostosis occurs the enlargement is usually quite visible, but it may be more easily detected by pushing the biceps slightly to one side. Anchylosis of the joint usually results after a very prolonged lameness often extending into years.

We have observed a case of rheumatic arthritis in a two-year-old cart colt in which distension of the synovial capsule of the shoulder-joint was evident. After blistering, the symptoms abated but the opposite shoulder-joint became affected. For six months the condition changed from one shoulder to the other repeatedly, and then suddenly disappeared.

Treatment.—Rheumatic arthritis may be improved by local blistering and the internal administration of pot. iodid., sod. salicylas, colchicine, alkalies, laxatives, etc.

Chronic arthritis seldom improves under any form of treatment. Firing and blistering may be tried, but as soon as bony exostoses make their appearance slaughter is most economical.

Luxation of the Shoulder-joint.—This is a rare condition, and usually occurs whilst landing from a jump or when the foot is fixed and cannot be freed.

We have observed the condition on several occasions in a steeplechaser. Whilst landing from a jump, luxation occurred and the animal fell. Attempts to get the horse on his feet brought about reduction, but lameness was intense for several days afterwards. This horse on several different occasions met with the same accident but reduction was always automatic.

As a rule reduction is difficult, and is effected by forced traction by a block and pulley attached to the affected limb whilst the operator stands on the shoulder-joint. Blistering subsequently produces sufficient pain and swelling in most cases to maintain the position of the bones. Some prefer a pitch charge. Rest in slings is always advisable.

Fracture of the deltoid tubercle of the humerus is by no means uncommon, either as a result of muscular action or from direct injury, as from a blow received whilst passing through a gateway or stable doorway. A kick from another horse may be responsible. When fractured the deltoid tubercle can be moved about with the fingers.

The symptoms resemble a mild form of radial paralysis. The knee and fetlock are flexed, the toe is dragged, and the animal has difficulty in advancing the limb. When the foot is placed in position the horse is able to stand his weight upon it. There has not been any appearance of "dropped elbow" in the cases we have observed. Occasionally the symptoms are less severe and only amount to slight difficulty in advancing the limb, with more or less flexion of the phalanges.

The cause may be loss of action of the deltoid and possibly of the postea-spinatus muscles, but this would hardly account for the severity of the symptoms often shown and the apparent loss of power in the lower extensor muscles. We are inclined to believe that the local inflammation set up by the fracture extends to the musculo-spiral nerve.

As a rule the deltoid tubercle forms a fibrous union with the humerus and restores the action of the deltoid muscle. Lameness usually disappears in six or eight weeks.

Treatment consists in securing rest and the application of a blister which contributes to that end by rendering the parts painful upon movement.

Chronic Inflammation of the Elbow-joint.—We are of opinion that chronic inflammation of the elbow-joint with resulting disease of the articular cartilage is more common than is generally believed. Post-mortem examination of several cases of supposed shoulder lameness has revealed chronic arthritis with ulceration of the articular surfaces of both the radius and humerus. The cause is unknown. Possibly kicks or small wounds of the sheath of the flexor metacarpi externus may infect the joint in some instances, but there was no evidence of this having occurred in the cases above mentioned.

The symptoms are similar to those of shoulder lameness. There is difficulty in advancing the limb and the animal assumes a three-cornered gait, the affected side being carried to the rear, whilst progression is mainly accomplished by the other limb. Swelling of the shoulder as the result of previous blistering is apt to deceive one into imagining that the shoulder is the seat of lameness, and in most cases there is indeed but little to distinguish elbow-lameness from shoulder-lameness. There is seldom any indication of pain upon pressure, nor is heat or swelling observable.

Treatment is useless, and in the event of a certain diagnosis being arrived at, slaughter is the most economical treatment.

Luxation of the Elbow-joint.—This accident is rare in the larger animals owing to the great strength of the lateral ligaments of the joint. Several cases have been reported in horses as the result of rupture of these ligaments from falls.

In dogs and cats luxation is sometimes observed, the radius slipping outwards.

An Airedale terrier was run over by a light rubber-tyred buggy. The wheel passed over the shoulder, producing complete external luxation of the radius. Reduction was effected under chloroform and the joint encased in a plaster bandage. This was removed after a week, when the animal was found quite sound.

In the dog the ulna may become displaced upon the radius with inability to extend the elbow. Flexion is but little interfered with. If not dealt with early, acute arthritis may result with swelling of the whole joint region and distension of the tendon sheaths at the back of the articulation. This condition is exceedingly painful.

Knee-joint Lameness.—Fractures of the small bones and chronic arthritis of the knee-joint may be met with.

Fractures are not common, as the small compact bones are well protected from concussion, but such cases occasionally occur as the result of falls particularly upon stones, or by contact with sharp bodies. Fracture of the pisiform bone has frequently been observed in racehorses and steeplechasers, from excessive contraction of the middle and external flexors of the knee. The intercarpal ligament uniting the pisiform to the external splint bone and the unciform is usually ruptured simultaneously.

Symptoms.—Fracture of the small bones of either row is difficult to diagnose with certainty. There is swelling and a painful condition of the joint, with severe lameness both in advancing and placing weight upon the limb.

Fracture of the pisiform gives rise to symptoms much resembling those of radial paralysis. The fractured portion usually becomes more or less displaced according to the amount of damage caused to the ligaments. Crepitation and increased mobility make diagnosis certain.

Prognosis.—Fracture of the small bones is usually comminuted and often compound. When union does occur, the resulting callus formation hinders or prevents movement of the other bones of the knee. The pisiform usually unites by means of a fibrous adhesion, and its function may be thus partly restored, but horses are of no further use for racing or jumping. "Bent-knee" is often a sequel. Recovery usually requires several months. It is not uncommon for laminitis to develop in the other foot through bearing excessive weight for so long a period.

Treatment.—The animal should be placed in slings, and the knee secured by means of a well-padded splint. Subsequently blistering and walking exercise on soft ground are beneficial and lessen the risk of anchylosis.

Compound fractures require strict antisepsis. Continuous irrigation of the knee which is kept at rest by a splint placed at the back will give the best results. Anchylosis is almost certain, and cases are seldom worth treatment except in breeding stock.

Chronic Arthritis of the Knee, sometimes referred to as "knee spavin," in causation, symptoms and treatment much resembles the corresponding condition occurring in the hock joint. Prognosis is, however, less favourable as anchylosis is more serious in the former position than in the latter, where the large joint between the tibia and astragalus provides most of the movement. Ponies seem to form the class of animal most frequently affected, though cart-horses and racehorses alike may develop the condition.

When the disease is confined to the lower part of the joint, movement may be only slightly interfered with. Lameness may be therefore hardly noticeable or severe, and is always, in the early stages at least, accompanied by marked swelling of the knee and the formation of a considerable amount of fibrous thickening. Later, this in great part disappears, and a hard bony swelling remains. Very often the knee is more or less bent and incapable of being fully extended or flexed owing to adhesions between the ulcerated articular cartilages and the formation of peripheral exostosis.

Inability fully to advance the limb causes the action to resemble that seen in shoulder lameness. Koller mentions three distinguishing characteristics of "knee-spavin" lameness:

(i.) The circular sweep of the limb when moved forward.

(ii.) The horse brings the quarter of the hoof to the ground first.

(iii.) Pain is produced when the joint is forcibly flexed.

Treatment must be confined to firing and blistering and median neurectomy when these measures fail to remove the lameness.

Rupture of the Interosseous Ligaments of the Knee.—This is a rare condition, but has been observed as the result of a fall whilst galloping.[1] At rest the knees nearly touched and were curved backwards. At the walk they were normally flexed, but the horse went on his heels as in laminitis. The knees were tender on pressure, and there was an increased amount of synovia present. Some amount of lateral movement was possible.

On post-mortem only the anterior ligaments were affected, and only those of the radio-carpal articulation.

Splints.—A splint is a bony enlargement developed upon the large or small metacarpal (or metatarsal) bones or upon both of these as the result of a localized osteo-periostitis. The inner side of the limb is more commonly affected although many cases occur upon the outside, and in fact both sides may be, and frequently are, affected simultaneously. Splint is most frequently observed in young horses doing fast work on hard surfaces. It is commonest at the age before complete natural bony union has occurred between the large and small metacarpals, that is to say, in horses up to five or six years of age. It does, however, sometimes occur in older horses.

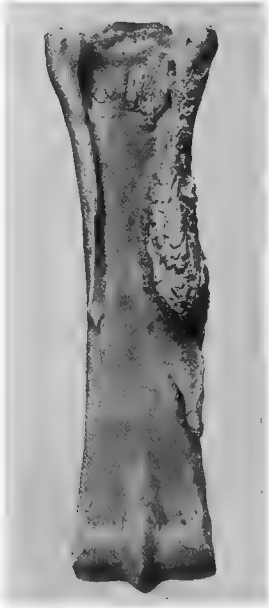

FIG. 144.—Splints.

Causes.—The actual cause of splint is osteo-periostitis, involving the large or small metacarpal bones. The exciting influence is concussion, which by throwing excessive weight upon the small splint bone causes tension of the interosseous ligament and inflammation of the adjacent periosteum. Dieckerhoff considered that the pull of the fascia of the forearm was responsible.

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[1] A. J. Williams, Vet. Lieut. A.V.D., *Vet. Record*, Nov. 16, 1901.

The predisposing conditions which favour the production of splints are small bone with diminished joint surface, and therefore greater concussion, employing young horses at fast work on hard roads, high action, faulty conformation and defective shoeing. When an excessive amount of bearing is given to the outer wall of the foot at the expense of the inner, as when the shoe is not quite true, increased strain is thrust upon the inner splint bone at each step.

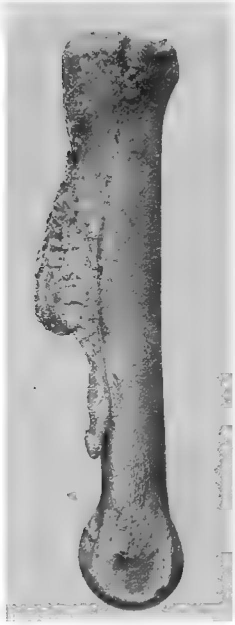

Fig. 145.—Splints.

Traumatic injury may also cause exostosis in this region, hence horses with turned-in or turned-out feet and those with high action may strike the inside of the splint bone many times during a single journey.

The Nature of Splint.—A splint is an exostosis occurring at the junction of the large and small metacarpal or occasionally of the metatarsal bones. In slight cases the periosteum covering the larger bone appears to be the origin of the enlargement, but in severe forms both large and small bones are involved and the latter are frequently affected with diffuse bony growths. The commonest situation of a splint is the upper or middle third of the small splint bone, but cases may occur in which enlargement even of the button is present, or it may extend the whole length of the bone. Several different terms have been applied to splints according to their situation. A simple splint is a small, well-defined enlargement usually at the front of the small metacarpal bone. Pegged splints occur on either side of the small splint bone, and are connected by a bony communicating bar. Knee splints involve the head of the splint bone, and may interfere with the action of the knee-joint, or may cause ostitis with arthritis as a sequel. Chain splints occur as a number of pea-like growths running nearly the length of the splint bone.

Splints of considerable size may also develop on the inner aspect of the small bones, and extend on to the posterior surface of the metacarpal bones, causing injury to, and displacement of, the suspensory ligament, and sometimes interfering with the play of the flexor tendons.

Symptoms.—Many horses exhibit well-developed splints without any history of previous lameness. It must be remembered that the large and small metacarpal bones are connected in the horse up to middle age by the interosseous ligament. Later, this becomes replaced by bone, excepting about two inches at the lower extremity, though in well-bred horses the large and small bones may remain distinct throughout life.

It is possible that many splints which develop without the production of inflammatory symptoms are the result of a premature but natural deposit of bone, stimulated by some local weakness of the bone tissue.

Lameness, however, may appear several weeks before any enlargement is noticeable, and one may be led to ascribe the symptoms to other causes.

The lameness nearly always increases with exercise, and is more noticeable on hard ground where concussion is increased than on soft ground where it is diminished. The horse may appear quite sound whilst walking, but may be very lame in the trot. The nodding of the head, the stilty gait, and general lameness are then quite out of proportion to that shown whilst walking. After a few minutes' rest the horse usually trots sound for the first dozen steps, after which lameness becomes evident. Pressure upon the affected spot causes pain, and is evidenced by lifting of the leg in a forward direction and resistance to further attempts at manipulation. The swelling is at first soft and doughy, later it becomes hard and bony.

When the splint involves the knee-joint, marked abduction is usually observed. Sometimes the knee cannot be properly flexed, and is carried stiffly in consequence.

Enlargement, due to striking with the opposite foot, is usually observable at the commencement of the lameness in contrast to splint lameness which usually precedes the formation of the exostosis. There is also more superficial injury, and frequently the skin is damaged over the affected part. Although bony enlargement may occur from this cause, in the majority of cases the greater part of the thickening is fibrous in nature. When a considerable enlargement is present the tendency to strike the spot is increased. Carefully noting the action from the front of the animal at various paces should lead one to a correct diagnosis.

Prognosis.—This is always satisfactory excepting in those cases in which there is interference with the action of the knee or flexor tendons, and when the splint is of sufficient size and in such a position that it may be struck with the opposite foot. Occasionally, upon resuming work inflammation may again arise with the production of fresh exostosis either as an extension of the pre-existing enlargement or in another situation.

The majority of young horses, however, after recovering from splint lameness do not show any reappearance of the symptoms in the same limb, though it is not uncommon for the opposite limb to become affected, especially in light horses deficient in bone.

Heavy horses doing slow work do not so frequently exhibit splint lameness. Enlargement of the head of the small metacarpal bone usually interferes with the action of the knee either mechanically or by causing changes in the articular surfaces of the opposed bone or bones. Chronic lameness is a frequent sequel, and although after a prolonged rest the action may be apparently restored, yet lameness usually reappears upon working the animal. Large splints on the postero-internal surface of the small bones may cause distortion of the suspensory ligament and bulging of the flexor tendons and more or less chronic lameness from a double cause, viz. interference with these soft structures and pressure of the same upon the splint.

Striking with the opposite foot causes intermittent lameness which in most cases can be benefited by special shoeing. Long " spongy " splints occurring throughout the length of the splint bones are frequently bilateral and indicate weakness of bone. Lameness usually disappears after a period sometimes extending to months.

Very rarely splint formation is attended by suppuration as a result of external injury during the inflammatory process. We have observed a case of this sort with an abscess cavity extending the whole length of the cannon and attended by exfoliation of bone.

Splints on the hind legs seldom cause lameness. When present they are usually found on the outer side of the metatarsal bone.

Treatment.—In mild cases cold fomentation, cold water bandages and the application of a cooling lotion, with rest or slow work may be sufficient to remove the lameness. In more severe cases this treatment should certainly be adopted until the acute inflammatory stage subsides somewhat. After about a week or a fortnight a biniodide of mercury blister may be applied and the animal, with the shoes removed, given a run at grass. Should lameness continue, puncture-firing, preferably deep acupuncture, gives the best results.

Acute cases attended with marked heat and pain and with a well-defined rather soft swelling are usually afforded early relief by subcutaneous periosteotomy. A short transverse incision is made below the seat of the splint, a strong periosteotomy knife is inserted flatwise under the skin. The cutting edge is then turned towards the bone and as the knife is withdrawn sufficient pressure is brought to bear upon it to sever the fascia and periosteum and to cause it to cut into the swelling. Aseptic precautions are advisable. The operator must avoid injuring the metacarpal vessels and nerve, though, as these lie usually well behind the splint, there should be no danger if reasonable care be taken.

Large enlargements which are struck by the opposite foot should be protected by a leather legging and blistered with biniodide of mercury. The offending foot should be carefully shod with a feather-edged shoe worn well beneath the inside wall, the edge of which may be rasped away. Sometimes a three-quarter shoe is useful whilst an ordinary shoe filed away at the ground surface of the inner branch, with a piece of leather the inside edge of which projects slightly beyond the foot, may prevent the animal striking with the shoe. Knee-splint can only be treated by point-firing and blistering. Neurectomy may be necessary to remove the lameness.

Careful attention must always be paid to shoeing, and it is especially important that the coronet should lie parallel with the ground surface so as to ensure even bearing and a minimum of concussion.

Chronic cases may be shod with leathers, rubber pads or tips with the same object in view.

Extirpation of splints by means of mallet and gouge or by bone forceps was formerly much practised, but is only admissible when a prominent enlargement forms a mechanical obstacle to movement of the tendons or when it is constantly being injured by the opposite foot and cannot be reduced by other means.

Sore Shins.—This is a common condition among young racehorses in training, particularly in two-year-olds.

The cause is usually periostitis of the metacarpal, or less frequently of the metatarsal bones resulting from concussion. In horses over four years of age the condition is rarely seen, as the bones then contain more mineral and less animal matter, are less vascular, and therefore more able to withstand impact.

The symptoms usually first make their appearance after a gallop. One or both legs may be affected, when only one at a time it is usually the leg the animal leads off with. The leg is rested or when both are affected the animal shifts his weight from one leg to the other repeatedly. The action is shuffling and restrained. Swelling of the front of the metacarpal region appears within the first few days. A subperiosteal exudate is thrown out and imparts to the enlargement a characteristic elastic, tense feeling. Later the overlying skin and subcutaneous tissues become œdematous and in very severe cases pus formation (purulent periostitis) may occur. This is not a common sequel. If the sub-periosteal exudate is very great necrosis of the surface of the bone may occur as a result of separation from the periosteum, or the exudate may be replaced by bone in the form of a casing around the old bone. Lameness then usually disappears. Mild cases, that is to say, those in which the condition is recognized early and immediately treated, usually recover without complication.

Treatment.—During the inflammatory stage cold irrigation by means of the hose pipe several times daily for half an hour, followed by the application of warm flannel bandages over a thick layer of cotton wool, may give relief and diminish the amount of exudation. When the latter is very great, puncture with a fine trochar or subcutaneous periosteotomy carried out under strict asepsis followed by an antiseptic dressing and a bandage is to be recommended, as it prevents further separation of the periosteum. After one or two days a biniodide blister should be applied.

Complete rest is at all times essential. When suppuration occurs, an opening should be made as low as possible for exit of the pus and antiseptic leg baths employed at frequent intervals.

Fracture of the Sesamoid Bones. *Causes.*—In most cases the actual cause of fracture is the opposing pull of the suspensory and inferior sesamoid ligaments at the moment that the greatest weight is being placed on the fetlock joint. Galloping on soft ground or on sand or slipping forward on the heel of the shoe on muddy ground whilst galloping may be the cause of the injury. Fracture appears more likely to occur after the animal has been confined to the stable for some time previously to being taken out.

The direction of the fracture may be either horizontal or longitudinal. The former is the more common, as will be understood when one considers the cause of the injury. Comminuted fracture also occurs and the bone may be broken into four or five separate portions.

Symptoms.—In horizontal fractures displacement of the fragments results in loss of function of the suspensory ligament. The fetlock therefore sinks towards the ground but does not actually come into contact with it so long as the flexor tendons remain uninjured. The hoof retains its normal position and there is no tilting upwards of the toe as is seen in rupture of the flexor perforans tendon.

Swelling, heat, and pain may be detected in the sesamoid region and occasionally crepitation may be felt upon manipulation, but in most cases this symptom is masked by the amount of swelling. More often a gap can be felt between the fractured portions immediately after the occurrence of the accident.

In longitudinal fracture dropping of the fetlock may not be observable.

Very severe lameness accompanies all forms of sesamoidean fracture.

Prognosis.—Cases of longitudinal fracture have been successfully treated, but horizontal fissures result in displacement, and bony union seldom, if ever, occurs. Fibrous union may take place, but this does not usually restore the animal's usefulness. Comminuted fractures are hopeless.

Treatment.—Rest in slings is imperative. The limb may be fixed in such a position that the fetlock joint is slightly flexed, by means of a patten shoe. To the toe of this a piece of light iron about $1\frac{1}{2}$ inch wide, $\frac{3}{16}$ of an inch in thickness and about a foot in length should be welded and then bent to follow the shape of the limb. The back of the sesamoid region is padded with several layers of cotton wool and then surrounded by a strong plaster bandage applied over the metal splint.

If union does eventually occur the heel of the shoe must be gradually lowered until a shoe with thin heels can be worn, and this should be continued for some time to avoid contraction of the suspensory ligament or flexor tendons. Blistering and a run at grass will then be advisable.

Inflammation of the Sesamoid Bones.—This condition is often associated with chronic inflammation and distension of the metacarpophalangeal sheath, the synovial membrane of which lubricates the pulley-like surface formed by the sesamoid bones and the intersesamoid ligament, and is reflected on to the flexor tendons. Both the anterior and posterior surfaces of one or both sesamoid bones may be affected. Ostitis occurs in the bones themselves and extends to the articular cartilages, which become ulcerated. These changes may also occur in the articular surfaces at the back of the metacarpus and eventually bony union may occur between the sesamoids and this surface. In long-standing cases the disease may extend to the fetlock joint with resulting exostosis and anchylosis.

The condition may occur in either hind or fore limb but more commonly in the latter.

Symptoms.—Lameness is usually constant but may not be severe. The fetlock is flexed whilst the limb is at rest. Upon starting off lameness is the more noticeable, the toe is dug into the ground for the first few steps and but little weight is placed on the heel of the shoe.

The sesamoid bones are enlarged and painful upon pressure. The flexor tendons are usually thickened where they glide over the roughened intersesamoid ligament, and there is in most cases an increased amount of synovia in the metacarpo-phalangeal sheath with corresponding distension. In the later stages contraction of the flexor tendons causes chronic knuckling at the fetlock joint, and anchylosis may exist between the sesamoids and metacarpal or metatarsal bones and sometimes between the latter and the suffraginis in addition.

Treatment.—In acute cases cold fomentation, cold water bandages, or bandaging over a thick layer of kaolin paste may be beneficial. Astringent, cooling lotions applied on cotton wool and covered by a flannel bandage assist in combating inflammation. A lotion of plumbi acet. and alum āā 1 oz. in one and a half pints of water makes a useful application in the early stages.

In chronic cases treatment is of little use. Firing and blistering may be tried sometimes with temporary success, but the lameness usually recurs upon severe exertion.

Median neurectomy is recommended, but may be followed by fracture of the diseased bones or rupture of the suspensory ligament or of the abraded flexor tendons.

Ringbone.—The term " ringbone " is generally used amongst horse-owners to describe any bony enlargement of the phalanges. Amongst veterinarians the expressions " true " and " false " ringbone are commonly employed. As these two conditions are pathologically and clinically unrelated much confusion has arisen from this description and in addition endless litigation, which in great part might have been avoided if only an agreement had at some time been arrived at amongst members of the profession as to what constitutes a ringbone.

Ringbone existing as an arthritis with slight exostosis is a very different matter from the point of view of a buyer or owner as compared with a large exostosis which is in no way connected with an articular surface. The former renders the horse more or less permanently lame and greatly decreases his value, the latter, though it may cause temporary lameness, is of far less importance, and may indeed never interfere with the animal's usefulness.

" High ringbone " denotes the condition when the articulation involved is that occurring between the suffraginis and the os coronæ ; " low ringbone " that occurring between the os coronæ and the os pedis.

Both these forms undoubtedly commence as an ostitis with extension to the articular surfaces and the subsequent or coincident production of exostosis around the margin of the joint.

The condition spoken of as " false ringbone " is neither more nor less than periostitis, an inflamed and over-active condition of the periosteum covering the shaft of the suffraginis or os coronæ without marked changes in either the bone tissue or the articular surfaces.

Causes.—The actual cause of ringbone is similar to that of spavin and many other chronic joint diseases, viz. concussion acting upon bone tissue which is from some cause lacking in its power of resistance. Heredity is generally recognized as playing an important part in the production of ringbone, either through transmission of certain conformation or of defective bone tissue. Probably the latter is more often the case, as we see very many horses with conformation conducive to concussion of the bone which develop no trace of ringbone in spite of years of hard work. On the other hand, statistics prove that when both parents are affected with ringbone, the offspring invariably develop the disease, and when affected animals are bred from for several generations ringbone occurs at an earlier age in each.

Strain of ligaments, which was at one time and is now by some observers considered a causal factor, seldom or never produces articular disease.

Both strain and concussion may produce periostitis and the formation of large exostoses, but these are purely surface disorders provided that the hereditary predisposition to ostitis is lacking. Strain of the ligaments of the phalangeal region is frequently the result of bad shoeing, unequal distribution of weight upon the wall of the foot through neglect in obtaining a level bearing, wearing the shoes too long a time and working on rough or irregular surfaces.

Periostitis may also be caused by traumatic influences, from blows, kicks from the attendant upon the coronet, deep wounds involving the periosteum and from incomplete fracture. We have reason to believe that the latter condition is much more common than is generally imagined. Great pain is usually manifested quite suddenly, and this alone causes the animal to rest the limb sufficiently to secure union of the undisplaced portions of bone with the resulting formation of a callus which is usually diagnosed as " ringbone." " Chip " fractures are the most common type, then next in order come " splits " of varying length. These are usually the result of jumping, prancing, galloping or rearing and landing upon the foot with the pastern held too straight or in such a position that co-ordination of muscular pull is lacking.

Lesions.—As before stated, ringbone is purely a bone disease with extension to the articular surfaces. Inflammation of bone tissue runs a course very similar to that of the softer tissues with certain special characteristics. The first stage is purely a vascular derangement. On section of an inflamed bone, undue softness is usually observed and change in colour from the normal either as an increased redness or a peculiar dark-blue coloration. This is observable through the semi-transparent articular cartilage. In due course inflammatory changes extend in the direction of the long axis in the case of the pastern bones until the perichondrium is reached. It must be remembered that articular cartilage itself possesses no nerves, blood-vessels, or lymphatics but is surrounded by this very vascular layer which apparently stands in a similar relation to cartilage as does the periosteum to bone. As a result of congestion in the parachondrium with resulting effusion the articular cartilage in certain areas becomes, so to speak, cut off from its origin and isolated. This occurs more readily in the cup-shaped articulation, the central portion of which lies nearest the inflammatory condition present in the centre of the bone tissue. It will almost invariably be found in the case of a bone such as the os coronæ, possessing one concave and one convex extremity, that the concave end is first affected. Hence, in "high ringbone" the upper articulation of the os coronæ is usually the seat of disease, and in "low ringbone" the concave articulation of the pedal bone. Continuous movement of the joint soon causes ulceration of the articular cartilage when the parachondrium becomes congested and the vessels of the latter being exposed to irritation and friction commence to bud and form granulations on the surface of the joint. The cartilage covering the opposing articulation may become removed by friction set up by the diseased surface of the opposing bone, but we believe that this is due more to mechanical causes than to disease. Two granulating surfaces are thus opposed to one another, and given sufficiently long rest and freedom from movement adhesion is the natural result. Effusion from the bone itself occurs simultaneously with these changes or from the internal surface of the periosteum surrounding the edges of the joint. This presently becomes more or less organised and appears partially cartilaginous. Lime salts then become deposited in this newly developed tissue and so the joint becomes surrounded by a layer of new bone, the exostosis, which completes the anchylosis of the joint.

If inflammation ceases at an early stage through removal of the exciting cause, such as concussion, recovery may occur and lameness may cease, but if the vascular changes have been sufficiently severe or prolonged to cause extensive effusion complete recovery is practically impossible. Bone elements have not the same capability of getting rid of inflammatory products as have the softer tissues, and their continued presence acts as would a foreign body, causing more or less continuous inflammation, especially after periods of increased concussion, and the production of fresh exostosis at intervals.

The so-called false ringbone is, on the other hand, in no way connected with inflammatory changes in the bone tissue, but is due to localized inflammation of the periosteum, principally at those areas which give insertion to ligaments or tendons. Concussion may play a part and the pull of the ligaments may increase the inflammation. Continuous slight strain acts as detrimentally as severe sudden strain. The former is in fact the cause of large exostoses surrounding the bones of the coronet, whilst the latter more frequently causes a small local exostosis which may never grow larger unless the strain be repeated. The deposit of fresh bone is developed from the inner surface of the periosteum, and the new growths, at least when of moderate extent, are covered by this membrane.

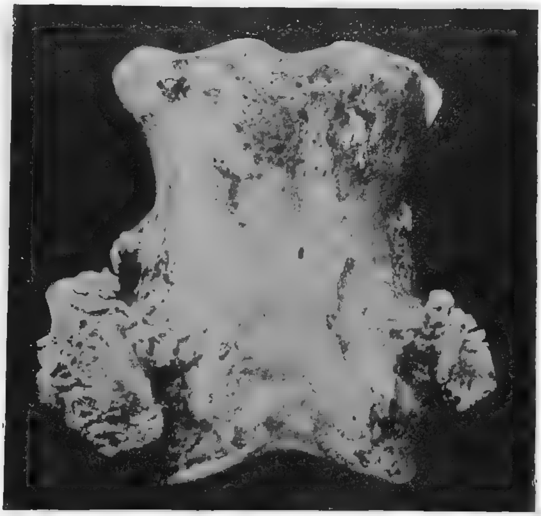

FIG. 146.—Pastern bone with exostosis—joint unaffected.

Prognosis.—Complete recovery in cases of ringbone is practically unknown, and when it has been assumed to have occurred there has been in all probability an error in diagnosis. Ulceration of the joint surface can never be remedied, and the most favourable termination that we can hope for is complete anchylosis of the joint, which will of course leave permanent stiffness.

Whether a horse can work without pain with an anchylosed joint is a matter which has caused endless dispute. In most cases anchylosis is not complete in the sense that the joint is quite immobile. This, of course, depends upon the fusion of exostosis and the union of the articular surfaces themselves. In the majority of instances this does not occur throughout, but the new growths on the opposed bones are in many places merely in contact, and although they prevent extension and flexion of the joint on the part of the animal, yet some movement still remains and pain is aggravated by their repeated contact and by the strain placed upon the completely anchylosed areas. New growths of bone are almost always more or less spongy and yielding, and if post-mortem specimens of the bones of affected coronets be examined, in very few will complete rigid fusion be discovered. Apart from this, the fixation of the joint, often with the bones in an almost straight line with each other, directly increases the concussion, and although the animal saves the limb as well as he may be able, yet if forced to do fast work on hard ground, pain must occur from both the exostosis and the inflamed articular surfaces. The only reliable method of determining the existence of pain when peripheral exostosis exists is injection of cocaine over the plantar nerves just below the centre of the cannon. This operation when properly performed gives definite information, as although it cannot give freedom to the joint, yet apparent diminution of the lameness when subsequently trotted on a hard road indicates that the condition is a painful one. Care must be taken to test the skin covering the affected region before coming to a conclusion in order to ensure that local anæsthesia has been definitely established.

Periosteal exostosis is not nearly such a serious condition as ringbone. Young horses frequently exhibit prominences at each side of the lower end of the suffraginis, which are termed by horsemen "anklets." In many cases these are not abnormal but are due to natural prominence of the bone.

Periostitis resulting from sprain is seldom or never associated with disease of the articular surfaces excepting in those cases in which true ringbone develops independently. There is no reason why a horse should not from conformation or lack of attention to level shoeing develop exostoses at the insertion of the lateral ligaments and yet subsequently develop ostitis and ringbone as the result of concussion, if bred from unsound stock.

Nevertheless lameness from periostitis uncomplicated by ringbone is a matter of frequent occurrence, and when there is no reason to suspect any hereditary tendency to ostitis there is in the majority of cases reason to believe that with due care in treatment and with removal of the exciting cause which in the majority of cases is neglect on the part of the farrier or owner, recovery may occur and the animal may remain, for some time at least, workably sound. Exostoses cannot be removed and any attempt at treatment with this object in view is useless. New growths of bone are always larger upon first being formed and diminish somewhat in size upon subsequent consolidation, but beyond this stage they cannot be lessened. Swelling of the tissues overlying the enlargement usually lessens when inflammation beneath the latter ceases.

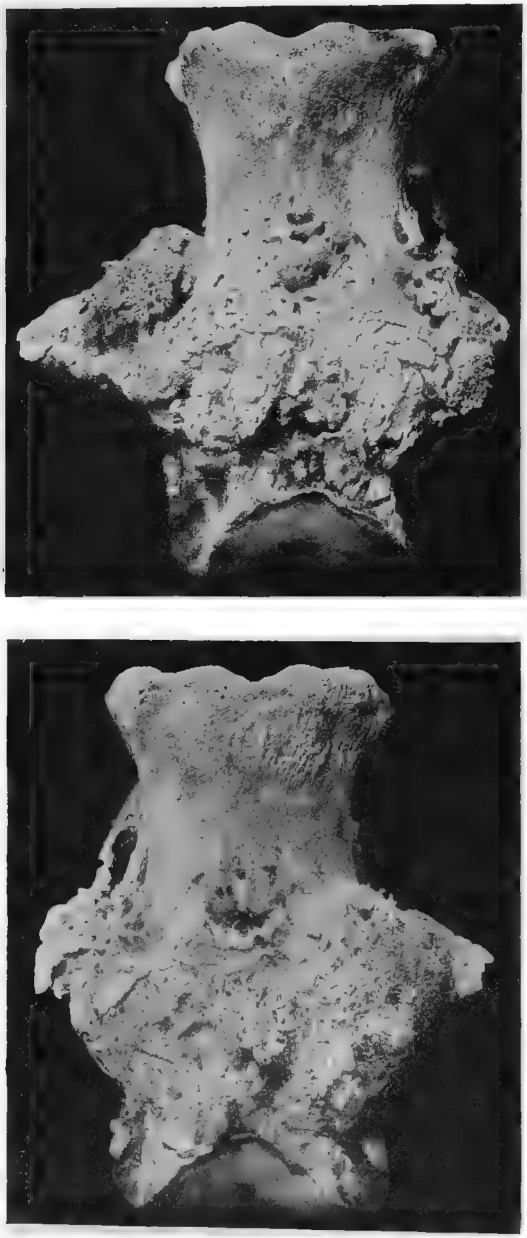

Fig. 147.—Ringbone disease. Anchylosed joints.

Bony anchylosis of the joint may occasionally occur as a result of periostitis arising from strain of the ligaments or contusion, through extension of the inflammatory changes round the joint or by the formation of a mass of bone in a particular part which may be an obstacle to complete flexion or extension. But in these cases the articular surface of the joint is not involved and upon the abatement of inflammation we see true mechanical lameness, not necessarily associated with pain. Fibrous anchylosis may also occur and cause similar stiffness without pain.

When the conditions which have caused the periostitis are not or cannot be removed, then lameness persists and may be continuous or intermittent. The ever-present irritation of the periosteum results in the formation of a gradually enlarging exostosis and the animal may become ultimately useless for work.

Ringbone may occur in either fore or hind limbs but more frequently in the former, probably owing to the increased concussion borne by them. It is more common to get ringbone than periostitis in the hind pasterns, hence bony exostosis in this situation is more commonly connected with arthritis and so permanent lameness more often results.

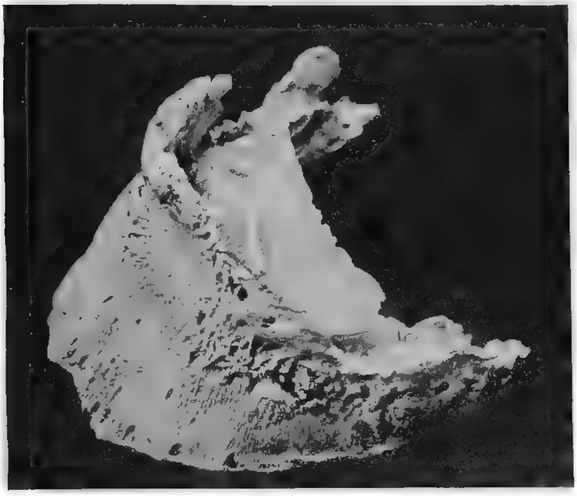

Fig. 148.—Pedal bone with exostoses in front of, but not involving articular surface.

The form of low ringbone affecting the coronary-pedal joint is often followed by exostosis of the pyramidal process (pyramidal disease), and as the parts are encased within the hoof constant pain results.

Symptoms.—The external appearances of ringbone may vary considerably from a large bony exostosis easily visible to very slight enlargement only distinguishable upon very careful palpation. Occasionally large outgrowths of bone may develop at the back of the joint under the flexor tendon and may interfere with its action.

In the so-called " pyramidal disease " the exostosis on the front of the pedal bone causes a marked bulging of the front of the hoof which grows down as a distinct ridge. Sometimes the foot appears almost triangular, with the apex in front.

Periostitis arising independently of ringbone usually commences on one or other side and extends towards the front of the bone. Sometimes diffuse exostosis occurs around the whole of the bone. The suffraginis may be included in the process.

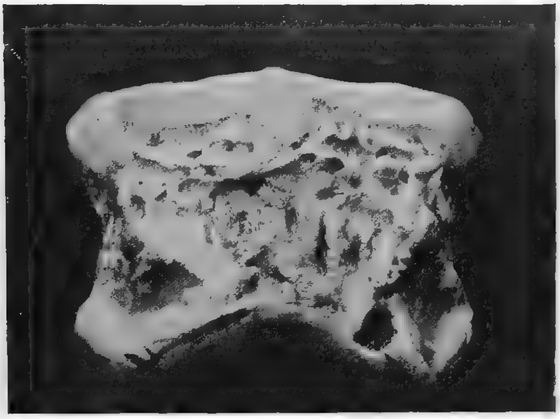

Fig. 149.—Os coronæ, exostoses on anterior surface.

The main difference in the two types of exostosis is that in ringbone the enlargement is chiefly to be felt around the edges of the articulations, in periostitis the enlargement is usually at about the centre of the shaft of the bone or at the point of insertion of the ligaments. As may be expected, periosteal enlargements may occur in the neighbourhood of the articular surfaces which cannot during life be distinguished from ringbone except by the symptoms exhibited. In these, unless anchy-

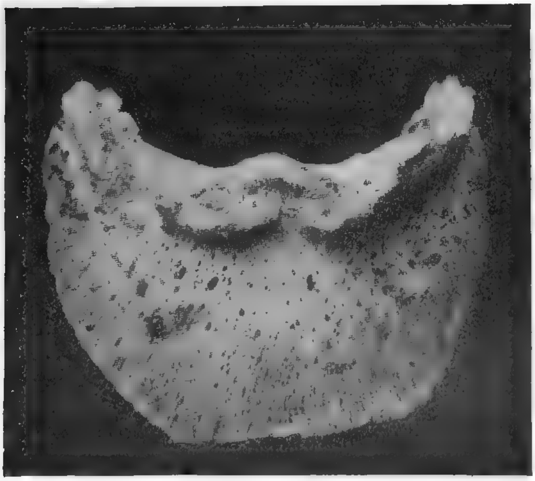

Fig. 150.—Os pedis, showing pyramidal disease.

losis of the joint occurs, lameness usually subsides after rest or treatment or may even never occur, whilst in true ringbone formation in the neighbourhood of a joint lameness never ceases altogether.

Frequently ringbone is complicated by sidebone. Ringbone formation is ushered in by gradually appearing lameness without any signs of heat and frequently without any evidence of pain upon palpation. The action of the horse usually suggests foot lameness, that is to say, the animal yields when the affected foot comes to the ground, at the moment when concussion is greatest. At rest the fetlock and coronet are carried somewhat straighter than usual. If the animal be rested at this stage, the symptoms may subside, but in most instances recur upon again working upon hard roads. It will be observed that lameness is noticeable before any bony enlargement appears. The appearance of the exostosis is gradual, and some months may elapse before it attains any great size.

Periosteal exostosis may occur gradually without lameness or it may be accompanied by lameness similar to that just described. If the animal be kept at work the degree of lameness will be found to vary from time to time, becoming worse or better in proportion to the nature of the work and the degree of concussion.

In ligamentous strain increased lameness is shown when the animal is turned towards the diseased side and when lateral movements of the foot are forcibly made.

Treatment.—No lasting benefit results from the treatment of ringbone when once the disease has become established.

If the disease be recognized in the early stages prolonged daily irrigations with the hose-pipe and rest, with the shoes off, in a paddock is the best treatment. Hot fomentation increases the amount of exudation and the degree of subsequent exostosis. If rest in a stable is given the animal should be kept on a soft bed of peat.

Shoeing must be attended to early, the foot must be kept level so that undue strain falls on no part of the joint. A leather under the shoe when at work lessens the amount of concussion. After a week or ten days of cold irrigation blistering or line firing may be tried, or point-firing may be tried if exostosis is developing. Should lameness abate after this treatment, no work should be performed for at least six weeks, and if possible the animal should be employed only on soft ground such as in farm work.

When ringbone is actually existent, relief may be obtained from double plantar neurectomy. The animal may thus continue at work for years, or fracture of the pastern or another sequel to the operation may occur very shortly.

Neurectomy is of more value in horses doing work on the land than on the roads.

The treatment of periosteal exostosis is more hopeful. In the early stages careful attention to the foot is essential, both sides of the foot must be made perfectly level so that the animal secures an even balance on the foot without undue strain on either side. This is more important than any other treatment. Cold irrigation followed by a blister and a run at grass may suffice in mild cases, but when large exostoses cause lameness, deep point-firing followed by blistering gives the best results.

Cases of suspected partial fracture should be rested and either encased in a pitch or plaster bandage or well blistered with cantharides. The resulting soreness will induce the animal to rest the limb and union may then occur.

Cab-horse disease is a name given to a peculiar form of lameness observed in horses working in buses, cabs, and vans, principally in the streets of large towns. In reality it is a type of high ringbone, but it is characterized by its position, viz. the inside and lower front of the fetlock joint.

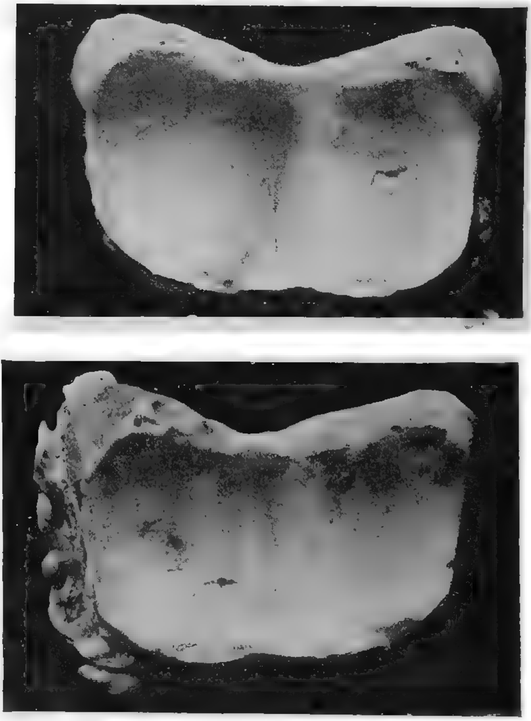

Fig. 151.—Os suffraginis showing lesions of cab-horse disease.

Cab-horse disease may be defined as an ostitis of the suffraginis associated with changes in its upper articular surface.

The cause is in all probability an ostitis dependent upon concussion and possibly hereditary influence. Paved streets seem conducive to the condition, which is only occasionally met with in the country. Traumatic influences have also been blamed, such as brushing with the opposite foot, but the situation of the enlargement renders this unlikely and there is usually no external sign of injury. Moreover, striking with the other foot would not account for lesions in the joint itself, though it might be responsible for external thickening.

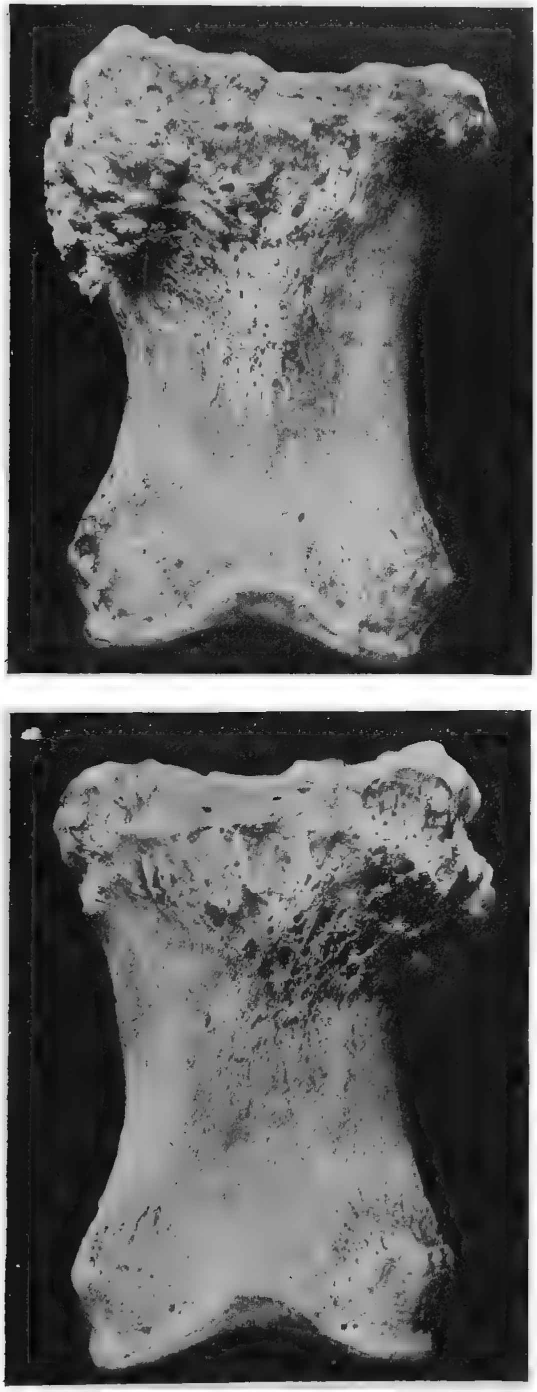

Fig. 152.—Cab-horse disease.

Symptoms.—This is mainly a disease of horses over middle-age. In the early stages the horse falls lame whilst upon a journey. After being brought home and rested he may again become sound in action until again worked. After a time lameness becomes more or less constant. On handling the part nothing can be detected; there is no indication of heat, swelling, or pain. This may continue for several weeks, the horse gradually becoming more and more lame. A bony swelling will then commence to appear on the inside of the fetlock joint; very rarely indeed is the outside affected. This exostosis very gradually increases in size.

The *lesions* observable on post-mortem are congestion and softening of the os suffraginis in recent cases, an increased whiteness and hardness in old-standing ones. Periostitis exists with exostosis of the head of the suffraginis, whilst the lower end of the metacarpal bone almost invariably remains intact. The articular cartilage is always affected with ulceration, and in some cases there is loss of tissue in the articular surface of the bone itself, particularly on the inner portion of the joint.

In some cases the condition is complicated by disease of the sesamoid bones which may become fused on to the back of the pastern bone.

Prognosis is always unfavourable, and cases seldom become sufficiently sound for town work, though if of sufficient size they may work on soft ground at farm work. The condition is, however, usually seen in light harness horses, which are unsuitable for anything but moderate draught.

Treatment is of little service. Attention to the bearing of the feet and puncture firing usually alleviate the condition but cannot cure it. Neurectomy of the internal or both plantar nerves or preferably of the median nerve may render the animal useful for a time. The internal plantar nerve should be divided immediately below the oblique branch which is given off from the external plantar and joins the internal an inch above the button of the splint bone.

Hip-joint Lameness.—Inflammation of the hip-joint is rare in horses but occasionally seen in cattle. The causes are forced abduction, as may occur in falling with the hind limbs straddled and bruising, which is not commonly seen; the bursa of the gluteus medius tendon is more frequently injured through this cause than is the joint.

In cattle we have on several occasions observed arthritis of the hip-joint with marked enlargement and exostoses on the rim of the acetabulum and head of the femur. These symptoms produce marked wasting of the whole body and continuous severe lameness. Possibly these were cases of articular rheumatism.

Symptoms.—In both horses and cattle the limb is advanced with a circular swinging motion at slow paces. In the horse whilst at the trot the quarter on the lame side is elevated with as little movement of the hip as possible and appears to come up with a jerk. "Three-cornered" action is usually noticeable; the affected limb is abducted, and the animal appears to move away from the lame limb.

At rest the foot may rest on the toe, with flexion of all the joints below the hip. When the lameness is severe the animal may only be moved with difficulty. The foot is held constantly off the ground whilst at rest, mainly by the action of the muscles below the hip region, allowing the gluteals to remain in a state of relaxation. Atrophy soon follows from inaction of these muscles.

Treatment.—Calkins on the heels of the shoes help to rest the hip-joint. In acute cases of strain or bruising cold fomentations may be employed, followed by blistering or firing and blistering.

Bruising of the hip-joint usually recovers in from a fortnight to a month, but arthritis and rupture of the ligamentum teres seldom respond to treatment, although post-mortem examinations have on several occasions revealed old-standing rupture of the ligamentum teres without any history of lameness.

Fracture of the acetabulum, of the head of the femur, or of the trochanter is occasionally met with.

Fracture of the acetabulum is characterized by loss of control over the limb, that is to say, abduction and adduction occur independently of the animal's will. In one step the limb may be adducted, in the next abducted. Crepitation is very distinct in the interval between fracture and the appearance of swelling, and can be heard every time the hand presses upon the muscles of the hip region.

Fracture may occur either in the head or at the neck of the femur. Marked abduction is usual, and lameness is apparent in all positions of the limb. Union by fibrous adhesion sometimes occurs.

The great trochanter or the third trochanter of the femur may be fractured by direct violence.

Union often occurs after several months' rest, but the connection is usually fibrous and not bony. In one horse used for dissection purposes at the Royal Veterinary College the third trochanter was attached by fibrous tissue but no lameness was apparent before slaughter. In another horse we observed fibrous union of the great trochanter and disappearance of lameness after three months' rest. The most visible symptom at the time of the fracture was shortening of the forward stride.

Luxation of the Femur.—This is an exceedingly rare condition in the horse, owing to the strength of the ligamentum teres and the cup-like shape of the acetabulum. In oxen this part of the articulation is not so deep, and cases of luxation are more commonly met with. Cases also occur in dogs occasionally.

Rupture of the ligamentum teres is necessary before complete luxation can take place, and in the horse fracture of the head of the femur is more likely to accompany or precede luxation.

In cattle, falling with the hind limbs "straddled" after leaping or service may result in rupture of the teres ligament and luxation of one femur or of both. The hind limbs are extended at right angles to the long axis of the body, and the animal is unable to rise. Often the adductor muscles on the inside of the thigh are ruptured and adduction becomes impossible. The animal lies upon the pubis or udder.

Treatment. — Reposition may usually be effected by placing a stout plank or log of wood between the hind legs and levering the head of the femur into position. It is, however, a matter of difficulty to secure it in the acetabulum. Rest in slings in the case of horses and a thick pitch charge applied over the joint may assist, but in cattle at all fit for the butcher slaughter is advisable.

Stifle-joint Lameness.—The stifle-joint consists of two separate articulations, the femoro-tibial and the femoro-patellar. Each joint is provided with its own synovial membrane, and in the majority of cases the two communicate by means of one or more small openings. This, however, is not always the case.

The lesions of closed arthritis may involve either or both of these articulations.

Dropsy of the stifle-joint, chronic serous arthritis, may exist, and must be distinguished from dropsy of the prepatellar bursa, which is present in most cases on the anterior surface of the patella and at times may be very well developed.

Fracture of the patella is rare. Cases of rupture of the straight ligaments and of the lateral ligaments are sometimes met with, whilst luxation of the patella, either partial or complete, is fairly common.

Chronic Inflammation of the Stifle-joint—Gonitis Chronica.—In most instances the femoro-tibial articulation is involved, together with the interarticular discs of fibro-cartilage. The changes in the joint consist in ulceration of the articular surfaces of the head of the tibia, particularly in the neighbourhood of the tibial spine, and corresponding changes on the condyles of the femur. The interarticular cartilages become degenerated and shredded, whilst osteophytes may appear upon the surface of the joint. The inner division of the joint is the more often affected; sometimes the external division shows no lesions whatever. The internal condyle becomes enlarged in advanced cases, and this may be appreciated upon palpation in the live subject. The synovial membrane is thickened and vascular, and may present a granulating surface with long villous projections.

Arthritis of the femoro-patellar joint is not nearly so common. Hunting and Porch, F.R.C.V.S., writing in the *Veterinary Record* of November 2, 1907, described two cases of stifle-joint lameness in which the lesions were confined to this joint. In both, "on the trochlea of the femur the cartilage covering the inner lip was thin and roughened; it was not ulcerated and it retained its translucent quality, so that through it could be seen a reddened and roughened surface of bone for nearly the whole length of the inner lip of the trochlea. The patella was unaltered, except that the articular cartilage corresponding to the diseased part of the femur was thin."

Apparently in neither of these cases was there any excess of synovia.

We have ourselves observed a case of chronic arthritis with very great distension of the femoro-patellar capsule and continuous pain and lameness which was followed by apparent recovery. Lameness ceased though slight enlargement remained, and the animal returned to work on the land. A week later the symptoms were as severe as before. Aseptic puncture, followed by a biniodide blister, again brought about apparent recovery, and a little later the animal was returned, but not being required for work was turned out to graze. In a fortnight he was brought back in a float in the same condition as previously. Destruction was decided upon, and a post-mortem examination carried out. The synovial capsule of the femoro-patellar joint was very much thickened, the synovial membrane was red and vascular-looking in parts, in others quite black and apparently necrotic. The joint cavity was distended with a clear watery fluid containing numerous flakes of fibrin. No change whatever could be detected in the articular surfaces of either femur or patella. In spite of the fact that the synovial capsules of the femoro-tibial and femoro-patellar joints are supposed to communicate, the former contained a normal amount of healthy synovia without clots and the synovial membrane appeared sound.

Prognosis.—Chronic arthritis of the stifle-joint with structural changes in the cartilages or articular surfaces is incurable.

The symptoms are usually developed gradually, and are apt to be wrongly diagnosed in the early stages before swelling appears. Occasionally several months or years elapse before the horse becomes useless.

Symptoms.—In disease of the femoro-tibial joint, whilst the animal is at rest the limb is held in such a position that the inflamed joint surfaces are kept as far apart as possible. To facilitate this the thigh is flexed upon the pelvis and the leg upon the thigh, whilst the fetlock is also flexed. In place of this attitude the horse may extend the hip and stifle and stand with the fetlock so far flexed that the front of the foot and the coronet rest upon the ground. Later, the limb may be held "in the air" with the foot clear of the ground and with all the joints flexed. When induced to work the animal shows pain upon advancing the limb, and the stride is always shortened. During movement the stifle-joint is usually fixed in a position of moderate or marked extension, and this accounts for the difficulty in bringing the leg forward.

Trotting is usually difficult or impossible. The limb is carried "in one piece" and the toe constantly strikes the ground.

On moving over in the stable, the horse frequently carries the lame limb and occasionally jerks it up, in a manner simulating stringhalt. This is evidently the result of sudden, severe pain.

Distension of the synovial capsule produces a swelling at the front of the stifle. Very often the external straight ligament seems to divide this swelling, and an enlargement is then visible a little to the outside and another immediately in front of the stifle. The tendon sheath of the extensor pedis may also be involved. This usually communicates with the joint capsule. The lameness may precede the appearance of the enlargement by some months, and is often intermittent in the early stages.

The symptoms of femoro-patellar joint lameness vary somewhat from those just described. They are well described in Hunting and Porch's article before mentioned, from which we will quote in brief:

"At the commencement of lameness the symptoms were not well marked—little more than stiffness of the hind limbs. Later the extensor muscles of the thigh showed excessive rigidity when the animal was moved. When made to walk, the hind legs were carried forward stiff and straight as though jointless, and the muscles in front of the femur were spasmodically contracted. Both hind legs were affected, but the near hind showed rather the more aggravated symptoms.

"There was no excess of synovia."

In another case the lameness was "at first, not well marked, chiefly stiffness. Then came the 'wooden' position of the hind limbs, for both were affected—the difficulty of movement when made to walk and the striking rigidity of the extensor muscles of the thigh, especially of the vastus externus and the tensor vaginæ femoris."

Treatment.—There is no beneficial treatment for chronic gonitis when once the diagnosis is certain. With care some cases may work on for years, but slaughter is usually necessary sooner or later.

Dropsy of the stifle-joint may appear soon after birth. In some respects it resembles bog-spavin in that it results from weakness of the joint, which may be hereditary.

Sometimes the condition is confined to one limb, frequently both are affected simultaneously.

As a rule lameness is not marked, unless the distension is sufficient to produce mechanical interference with movement of the joint. In this case there will be shortening of the stride and slight abduction or circular movement of the limb. The limb whilst at rest is frequently held with the stifle and hock semiflexed and the front of the foot and coronet resting upon the ground.

Treatment.—This is seldom required or even advisable excepting in horses used for exhibition purposes. Blistering is seldom successful; in working horses line-firing and blistering may give better results.

Aspiration and subsequent injection of hydrarg. perchlorid. solution 1 in 1000 or a 1 per cent solution of potass. iodid. has been recommended. Successful results have been recorded, but great care as regards asepsis and technique are called for. Sometimes in young horses the condition disappears spontaneously.

Fracture of the Patella.—This is a very rare condition in animals. The cause may be traumatic, such as from falls, kicks, or blows, or the patella may be broken by muscular action (inco-ordination). In the former case the fracture may be comminuted or vertical and is frequently compound, whilst in the latter it is usually transverse.

Symptoms.—Weight cannot be borne upon the limb, and movement causes great pain. There is inability to extend the stifle. Swelling of the tissues covering the front of the joint appears rapidly and disguises crepitation.

Prognosis.—Many cases of simple fracture unite by fibrous adhesion if given rest and time, and so the action of the extensor muscles becomes re-established. On the other hand, in fractious patients recovery may never occur owing to inability to keep the limb at rest. Andrien reported recovery of a compound fracture, attended by escape of synovia, in two months, though such success is exceptional.

Treatment.—Rest in slings with the stifle extended gives the best chance of success. As it is difficult to effect this in horses one may try fixing the hock-joint in a position of moderate flexion, which will often produce extension of the stifle. Small animals may be bandaged.

In the horse, blistering may hasten union and lessen movement. Large callus formation need not be feared as the patella is practically devoid of periosteal covering and the blood supply is scanty. In vertical and some comminuted fractures the fibrous covering of the bone assists in keeping the pieces together.

Luxation of the Patella.— In the horse the groove of the trochlea is nearly vertical in direction and the inner lip is much the more prominent of the two. In the ox the upper extremity of this lip is somewhat flatter than the remaining portion, that is to say, if the rim of the trochlea be regarded as the segment of a circle drawn around a given centre, the upper portion of the rim would be nearer to that centre.

In the horse, the inner lip of the trochlea is also the more prominent but its upper edge is even less rounded than in the ox, and in many instances appears slightly concave.

In the dog the lips of the trochlea are of equal height.

Luxation of the patella may be (*a*) Upwards, or (*b*) Lateral:

Upward Luxation of the Patella.—This may be complete or partial. By partial or momentary luxation we refer to that condition in which the patella becomes temporarily fixed during motion.

The *causes* of upward luxation may be slackness of the straight ligaments, spasmodic contraction of the rectus and vasti muscles, or defective shape of the trochlea. It is certain that the joint must be fully extended before upward luxation can occur. The patella then rides upon the trochlea to its highest point, which, as before mentioned, is flatter than the lower portion, and there becomes arrested. The internal lateral ligament may become fixed upon the bone, or the extension may be sufficient to allow the bottom edge of the patella to rest upon the inner trochlea.

The *symptoms* are characteristic. The condition may be only momentary and recurrent, or the patella may become upwardly luxated so that the animal cannot effect reduction unaided. Momentary or recurrent luxation is more often seen in slack-jointed colts and young horses out of condition, though it may occur in older animals. Lameness may vary according to the extent of luxation. At the trot, the foot appears to rest for a moment just as it leaves the ground, or in more severe cases the animal may be trotting quite naturally when suddenly the hind limb becomes abnormally straight, *i.e.* extended, and is carried behind the other like a wooden leg. After one or two steps the symptoms may disappear and normal action may be resumed, or the condition may exist for several seconds or minutes.

Complete upward luxation is more common in older horses. It may occur as the result of undue extension, as from falls with the hind limb extended backwards, from kicking, failing to clear a jump, or from slipping the limb backwards whilst pulling hard.

In recurrent luxation we must suppose that the patella becomes fixed above the normal height by the tension of the lateral ligaments which hold the bone tightly against the less-curved portion of the trochlea. This may be facilitated by slackness of the straight ligaments. In complete upward luxation, however, the base of the patella actually rests on the flattened or concave area at the upper extremity of the condyle.

Whilst the bone is in this position the stifle remains extended to its utmost, and, as all the other joints of the hind limb must follow suit, the limb is stretched out behind the animal and cannot be flexed even with external assistance, unless the patella be first restored to its normal position.

Prognosis.—Even in colts the prognosis of recurrent luxation is by no means favourable. Occasionally cases recover, and these may be due to slackening of the straight ligaments through ill-health. Congenital luxation is seldom curable in our experience in spite of treatment, and by the time that the foal has become old enough to carry a surgical shoe, the trochlea will have become roughened and diseased from constant displacement of the bone. Cases of complete luxation may recover under treatment so that in three or four days lameness may be absent, but there is always a predisposition to a repetition of the luxation under similar circumstances.

Treatment.—Recurrent luxation requires rest and attention to the general health of the patient. Thin, anæmic colts require tonics and nourishing food. Blistering the stifle appears to be beneficial, probably because it thickens the skin overlying the patella and provides a natural bandage.

To avoid luxation whilst at rest or at pasture, a rope may be attached from the hind leg, just above the hock, to a collar or neck-rope, or a strap with a D attached may be fastened above the hock and connected to a neck-strap by means of a stout elastic band. A shoe with a "toe-prong" attached answers a similar purpose, as also does a temporary shoe fitted with a thick toe-piece and calkins, which enforces moderate flexion of the limb by raising the foot from the ground. For running at pasture a "patten-shoe" with a toe-piece is preferable as calkins sink into the soft earth.

For work, a shoe with a thickened toe is usually efficient.

Complete or "stationary" upward luxation is reduced by one or other of the following methods :

(1) By drawing the foot forward by means of a rope applied around the hind fetlock and passed through a collar or neck-rope, and then backing the animal whilst downward and outward pressure is exerted upon the patella. This method is usually successful.

(2) By sudden backing or turning movements, accompanied by an unexpected blow from a whip. This causes contraction of the extensor muscles, which may free the patella.

(3) By manipulation of the patella whilst the animal is under the influence of chloroform.

Section of the internal straight ligament has been recommended by many Continental veterinary surgeons for the relief of recurrent luxation. The division should be effected at its insertion into the tibia to avoid injury to the synovial capsule.

Lateral Luxation of the Patella.—In the horse and in cattle the patella usually becomes displaced outwardly, but in the dog inward luxation is more common.

The *cause* is usually stretching or rupture of one of the lateral ligaments of the joint. The symptoms differ from those of upward luxation, as the lever action of the patella is lost and the extensors of the stifle-joint are rendered powerless to straighten the limb.

Continuous flexion of all the joints is therefore seen, and the symptoms very much resemble those of crural paralysis. The rectus and vasti muscles are still capable of advancing the limb, which is carried forward under the body but is incapable of bearing weight, so that the quarter of the affected side sinks when the foot comes to the ground. The patella, in its altered position, appears as an enlargement on the antero-external aspect of the stifle and is clearly visible.

Treatment.—Reposition in horses and cattle is usually difficult, but in dogs it is easy, though in all animals the greatest difficulty will be found in keeping the bone in position subsequently.

Forced extension of the limb by means of a rope attached to the fetlock and carried through a neck-rope or collar may assist reduction, which is effected by lateral pressure. Considerable ingenuity will be required to maintain the patella in position. In horses slings and a pitch charge or a blister may be successful. In dogs pitch bandages are best.

Luxation of the Femoro-tibial Joint.—This condition has sometimes been observed in cattle as the result of external violence, usually from falls over banks or into ditches. The direction of the luxation may be backward, forward, or to either side.

Backward luxation is more common.

Symptoms.—The leg is extended backwards, rigid and immobile. When the animal is made to walk the claws are dragged and the sole of the foot cannot be brought to the ground. There is always deformity of the stifle region, varying according to the direction of luxation. After a short time local swelling appears and may give rise to some difficulty in diagnosis.

Treatment.—Reposition may be attempted by passing a length of webbing or a rope around the thigh or cannon, and applying traction by means of a block and pulley. Simultaneous pressure upon the head of the tibia in the required direction may be successful. As luxation of this joint is accompanied in most instances by extensive rupture or stretching of ligaments, luxation is liable to recur, and in any but valuable animals slaughter for food is to be advised when other circumstances permit.

Rupture of the Straight Ligaments of the Patella.—Rupture of the external straight ligament may result from direct violence or sudden strain. The condition is very rare.

The symptoms are supporting leg lameness, pain upon pressure, and the existence of a hollow where the external ligament normally exists. The patella does not become displaced and the limb is capable of being extended and flexed.

Treatment is merely a matter of complete rest. Recovery usually occurs in one or two months.

Tibial Lameness.—Under this heading we refer to those cases of lameness due to injury to the tibia without *apparent* fracture.

The causes of such injury may be kicks from other horses, particularly where animals are tied on " lines " or where bails are used, getting the hind leg over a " bail," or becoming " hung up " in a gate or fence whilst jumping. The seat of the lameness is usually the inner side of the tibia, where it is most exposed and covered only by the tibial fascia and the skin.

The lesions produced vary according to the nature and degree of the injury. The periosteum may be alone involved and periostitis may result, occasionally with the occurrence of suppuration under the tibial fascia and sometimes with the formation of a bony growth which may extend the length of the bone.

More violent injury usually produces fracture, which may be of several different types. The bone may be dented and " starred," that is to say, from a central point fissures radiate involving only the superficial layer of the bone. Later these splinters may become displaced and set up suppuration, extending throughout the inside of the tibial fascia with necrosis of this tissue.

As a result of the injury the bone may be deeply fissured and yet, being tightly bound by the periosteum and tibial fascia, displacement may never occur, or it may be produced even weeks later by a violent muscular effort overcoming the resistance of the surrounding tissues.

Symptoms.—Tibial lameness is usually of a more or less severe character, although many cases of fracture occurring suddenly whilst at slow work must be attributed to previous injury (deferred fracture) which has caused an undisplaced fracture unattended by lameness.

There is usually both supporting and swinging leg lameness, though the former is usually the more marked. The horse frequently comes out of the stable exhibiting symptoms greatly resembling acute foot lameness. In more severe cases the leg is carried and movement is accompanied by groaning. Palpation of the inner tibial region reveals pain, and frequently the overlying skin is œdematous or a tense elastic swelling can be felt along the course of the bone (subperiosteal effusion). Later, exostosis is frequently observable.

Pressure upon the sensitive parts causes lifting and abduction of the limb, and in severe cases the animal may almost fall.

Treatment.—With the possibility of fracture always borne in mind, we must at first insist upon rest in the stable, and on some occasions slinging may be necessary. Periostitis may be treated by warm fomentations, or a narrow bag of sacking fastened above the hock and of sufficient length to reach to the stifle may be packed several times daily with hay steeped in hot water. This retains its heat for some hours.

Hot poultices made by mixing powdered kaolin with hot water and a little treacle to produce a hygroscopic action, kept in position by stitching sacking around the limb after applying the material thickly on cotton-wool, retain their warmth and moisture for at least twelve hours and are very effectual in relieving local inflammation.

If subperiosteal exudation is excessive, as is evidenced by the presence of a tense *elastic* swelling, cold applications are best and should be followed by a mild biniodide of mercury blister.

Suppuration and fracture must be treated on surgical lines.

Spavin.—It is a very difficult matter to provide a definition of spavin which will cover the condition in all its aspects. The generally accepted description is a bony enlargement on the lower and inner aspect of the hock. This is hardly sufficiently definite, as many cases of disease involving the articular surfaces of the bones are attended by little or no apparent bony enlargement. Moreover, commencing ostitis may be accompanied by lameness without visible change in the appearance of the hock, which may persist for some considerable length of time, and yet the condition must be considered as spavin from the commencement.

Occasionally the external surface of the hock may be the seat of enlargement, and in a number of such cases the lesions are identical with those seen on the internal surface in a typical case of spavin.

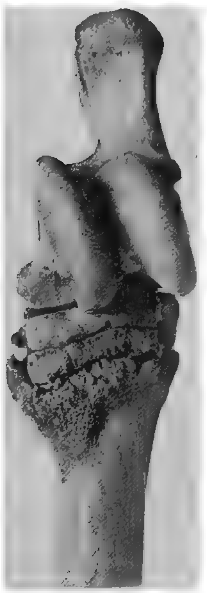

FIG. 153.—Bone spavin.

The Nature of Spavin.—Spavin probably originates as an ostitis. Many observers have regarded it as primarily a diseased or strained condition of the ligaments, and there is evidence to prove that cases of exostosis on the inner lower aspect of the hock may indeed arise from this cause. But, when these enlargements are examined post mortem true bony anchylosis and lesions of the joint surface are invariably absent. Fibrous anchylosis may exist in a few, but the appearance is easily distinguishable from true spavin.

It is evident that the majority of cases of spavin commence as a rarefying ostitis attacking, as a rule, the head of the metatarsal bone first and then extending to the cuneiform and scaphoid bones. Sometimes only the large cuneiform and scaphoid are affected. The cuboid is but seldom involved.

The changes first occur in the deeper portions of the bone and then extend peripherally towards the edges, or upwards or downwards to the articular surfaces, or in both directions. Breaking down of the bony tissue results in the production of small cavities which become filled with granulation tissue. Later condensing ostitis or osteo-sclerosis follows and results in anchylosis and exostosis.

Sometimes the ostitis extends peripherally only, resulting in peripheral anchylosis without changes occurring in the articular surfaces; sometimes the latter are affected with ulceration of the cartilages and subsequent anchylosis without the production of exostosis on the edges of the bone. This condition is spoken of as "occult spavin."

A few veterinarians consider that spavin arises as an inflammation of the bursa of the branch of the tendon of the flexor metatarsi which is inserted into the cuneiform parvum.

This bursa is frequently involved in the process of spavin formation, as the cunean tendon crosses the seat of spavin. When the exostosis is large and in a painful condition the tendon no doubt causes pressure and exaggerates the pain, but there is no evidence to support the view that the changes which occur originate in the bursa itself. Section of the cunean tendon has been practised for a long time for the relief of spavin lameness, but it is probable that the good results which have often been observed have been due more to the irritation and inflammation caused by the process than by lessening the pressure.

Causes.—One of the most commonly accepted theories explaining the prevalence of spavin is hereditary influence. Exactly what is transmitted from parent to offspring is not stated; by some it is regarded as weakness arising from defective conformation, by others as being due to the character of the bone-tissue itself. Conformation of the hock has apparently very little to do with spavin formation. Turned-out hocks, cow-hocks, sickle-shaped and "tied-in" hocks have all been blamed, but the fact remains that we see hocks of every description unaffected with spavin as well as we see perfectly shaped hocks with spavin enlargement. Conformation of the body or the limb as a whole apparently does exert some influence according to the degree of concussion which is transmitted to the bones of the hock. Thus straight pasterns and heavy quarters may play their part in the production of spavin. Nevertheless, the condition does not appear to occur more in one class of animal than another. Horses working on soft ground, riding horses carrying heavy weights on hard roads, harness horses, ponies used for fast or slow and comparatively heavy work may all or none develop spavin, but there appears to be no particular tendency to do so in one more than in another. Working horses at too early an age is also frequently blamed, but on the other hand we often see young horses which have done no work with well-developed spavin. Also, too, we frequently observe the early stages of the disease in old horses which have never exhibited hock lameness in earlier life. We can only conclude that the tendency to ostitis is handed down only as regards the bone-tissue itself and that it exists in a varying degree, *i.e.* it may be sufficiently pronounced to occur in an unworked two-year-old or the tendency may be so slight as to resist years of hard work. Possibly the process is only an attempt on the part of nature to strengthen that portion of the limb least adapted to fulfil its function.

Apart from concussion or compression a local inflammatory condition of the tissues surrounding the hock may produce exostosis on the seat of spavin. Sprain of the ligaments during the act of jumping or through slipping or external violence may produce bony enlargement following a period of acute lameness. From a veterinary legal point of view this too must be considered as spavin, although in a stallion or brood mare the tendency to transmit spavin need not necessarily be present. As before stated, articular anchylosis is in this case rarely present, and true peripheral anchylosis does not always exist although the bones may be considerably enlarged.

Peters considered that spavin resulted from strain of the ligaments due to rotary movements of the lower bones of the joint. As the joint between the tibia and the astragalus is a ginglymoid one and its axis lies obliquely to the body, and as the two tibiæ converge from above downwards, whilst the two metatarsal bones are practically parallel, he concludes that when weight is placed on the limb the muscles rotate the joint as well as extend it. The weaker lateral ligaments of the small bones have therefore to take the most strain, and this he considered set up inflammatory changes in the periosteum.

Symptoms.—Lameness may be apparent before enlargement occurs. In occult spavin the latter is entirely absent whilst the lameness is usually very marked. In some cases, however, horses develop considerable bony enlargements without exhibiting any lameness at all, or in any case not sufficient to attract the driver's or owner's attention.

The diagnosis of a spavin is not always by any means an easy matter when the animal does not exhibit lameness. When well developed, it is patent to the trained eye and touch, though in some cases one hock may vary considerably in profile from the other and yet be perfectly sound. A brief consideration of the surface anatomy of the inner aspect of the hock is necessary before proceeding further. The prominent blunt tuberosity on the lower and inner surface of the astragalus is easily felt. The lower edge of this marks the line of articulation of the latter bone with the scaphoid, the more or less prominent rim of which can be traced by the finger. Slightly lower will be felt a groove running inwards, then backwards and upwards. This represents the junction of the scaphoid with the large and small cuneiform bones, the edges of which may then be palpated. A groove running from above downwards may be detected which joins the horizontal groove described above. This is the separation between the large and small cuneiform bones. Below the prominent ridge of these latter is yet another horizontal groove representing their articulation with the metatarsal bone. In a thin-skinned horse the cunean tendon of the flexor metatarsi may be felt running inwards and downwards from the front of the hock into the cuneiform bone in line with the chestnut. The head of the small splint-bone, above which lies the cuboid, must be carefully felt. Enlargement of the head of this bone may be confused with true spavin.

The ridges on the scaphoid and cuneiform bones vary in size in different horses, and frequently even in the two hocks of the same animal. Excessive prominence of these gives a feeling of roughness and a prominent appearance, to which the term "coarse hocks" has been applied. "Odd hocks" signifies the condition when the ridges are developed more on the one hock than on the other. Without careful palpation one may be deceived into thinking that a spavin exists when as a matter of fact the hocks are sound.

When the animal is lame from spavin there may be recognized certain symptoms which are more or less characteristic. In the first place, lameness is most marked when the animal starts to move, and it tends to diminish or even disappear with exercise. This is, however, not the case in "occult" spavin lameness, which does not improve as the horse goes farther. Lameness is continuous in this form. In mild cases of spavin, lameness may only be evident after the horse has rested after violent exercise. In marked cases of lameness the toe is dragged slightly along the ground for the first few steps; when in harness with a heavy load, stumbling with the affected leg may sometimes be noticed upon starting. The toe of the shoe always shows wear in advance of the heel. As the animal progresses the heel comes more and more to the ground, and after trotting a mile the heel may be brought down and lameness may disappear until such time as the animal is rested, after which the symptoms will reappear.

The affected hock is not flexed to the same extent as the sound one. This may be observed either when the horse is trotted past or when viewed from behind, when it will be noticed that the point of the spavined hock is not lifted as high as its neighbour. The limb appears to be carried "in one piece," the extension of the limb being mainly conducted from the hip and stifle whilst the fetlock is moderately flexed. The reason of this lack of flexion of the hock is usually ascribed to rigidity resulting from anchylosis, but when we consider that practically all extension and flexion movements of the hock occur in the joint between the tibia and astragalus, this hardly sounds feasible. The real explanation probably is that the limb is carried in the position which causes the least pain. Probably Peters's theory of rotation may explain this. When the limb is extended and the foot takes the weight of the body, a certain amount of rotation occurs between the small bones of the hock and the metatarsal bones. By flexing the hock and lessening the weight on the limb, by bringing the toe first to the ground with the fetlock slightly flexed, this rotary movement with its accompanying pain is avoided.

Another symptom observable in long-standing cases is atrophy of the gluteal muscles. There is also a peculiar dropping of the affected quarter at each forward stride, which may best be observed from behind the animal.

Atrophy of the gluteal muscles appears to occur whilst the animal is kept at work, but disappears if rested in the stable for some weeks.

The late Mr. Hunting explained this fact in this way. So long as the horse works the painful condition of the hock remains, and in the stable is aggravated. He therefore rests the limb and the gluteal muscles are in disuse between journeys. In other words, during twenty out of twenty-four hours of the day the muscles are out of use. When work ceases altogether, pain in the hock grows less and so the gluteal muscles gradually come into use and atrophy abates.

Old-standing cases of spavin are often complicated by chronic contraction of the flexor tendons resulting from constantly flexing the fetlock whilst at work and at rest.

In the stable this constant flexion of the lower part of the limb is very noticeable. When turned from side to side lameness is more evident when moving away from the lame leg.

The lameness is often of a more or less intermittent character, and it is not uncommon in the early stages to find the horse sound one week and lame the next, and *vice versa*.

The so-called " spavin test " is conducted by holding the limb with the hock fully flexed for half a minute. Upon subsequent movement lameness is greatly increased. This test is not at all a safe guide, as many other conditions may cause the same increased lameness after forced flexion, and in old horses it is not at all a reliable test.

Prognosis.—In the majority of cases marked lameness only accompanies the acute inflammatory symptoms, that is, the period of acute ostitis. The development of large exostosis with complete fusion of the small bones involved usually brings about improvement and the animal may even trot sound and remain so. A really large spavin is usually less likely to cause future lameness than is a small one. In the latter case, when ostitis has been confined to one or two bones or has terminated in only a moderate degree of anchylosis, relapse is more liable to occur either as the result of imperfect fusion or from the development of ostitis in other parts of the hock. Spavin in young horses which have done little or no work is usually more serious than in older animals. Some animals never recover their soundness of action, constantly wearing the toe and imperfectly flexing the hock. In these cases atrophy of the gluteal muscles is usually persistent, and this is often regarded as an indication that the animal is suffering pain to a greater or less degree whilst at work. It is probable, however, that carrying the limb for a considerable time in this position results in contraction of the tendons and adaptation of the ligaments to such an extent that the leg becomes more or less fixed in that position. In those cases in which lameness continues after anchylosis is complete, soreness in the bones themselves, increased by concussion, is probably the cause. The ostitis may possibly be subacute or chronic.

Cases which recover under treatment usually require resting for at least six weeks. Twelve weeks is to be preferred when the animal can be spared sufficiently long. The prognosis in cases of " occult " spavin is always unfavourable, and after six months' to twelve months' rest and treatment lameness may be as severe as before.

Treatment.—In order to secure union of the granulating areas of bone, rest is essential. Recovery seldom, if ever, occurs whilst the animal remains at work. The general rule is to turn the horse out in a flat field when weather permits, though certain practitioners insist upon complete rest in a stall, and some even forbid the animal to be taken out of the stable for as long as two months whilst other remedial measures are being carried out. This method of treatment certainly produces excellent results and appears quite rational.

The surgical treatment of spavin has made no great advance for over a century. Firing, blistering, and other forms of counter-irritation are still employed and apparently aid in bringing about recovery, either by hastening the production of the inflammatory deposit or by increasing the local pain and securing voluntary limitation of movement of the affected joint.

The actual cautery is far preferable to mere blistering. Line-firing, pyro-puncture, needle puncture are all in vogue. Probably the best method is line-firing with the addition of one or two applications of the pyriform iron at the most prominent points of the enlargement. If this situation is selected there is practically no risk of opening the joint. The internal metatarsal vein must be guarded against accidental puncture.

The operation of firing may be followed by the application of a blister. Biniodide of mercury ointment mixed with cantharides ointment is the most useful for this purpose. Some practitioners recommend aseptic firing. The skin is first disinfected and the lines or points are subsequently dressed with iodoform or bathed frequently with an antiseptic.

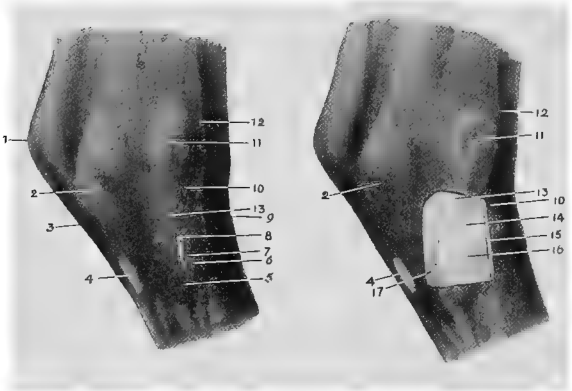

FIG. 154.—Inner side of hock.

1, Point of hock; 2, groove marking position of the tarsal sheath as it accommodates the flexor perforans tendon; 3, posterior border of hock marking position of flexor perforatus tendon and underlying calcaneo-metatarsal ligament and os calcis; 4, chestnut; 5, anterior border of metatarsus indicating location of extensor pedis tendon; 6, line of incision for cunean tenotomy; 7, lower transverse groove marking lower border of cunean tendon; 8, upper transverse groove marking upper border of the cunean tendon; 9, position of extensor pedis and flexor metatarsi; 10, seat of bog-spavin, place at which the anterior ligament of the true hock-joint is unsupported by tendon; 11, internal malleolus of tibia; 12, ridge formed by internal metatarsal vein; 13, position of tubercle on inner side of astragalus; 14, cunean tendon; 15, internal metatarsal vein; 16, astragalo-metatarsal ligament as it covers the cuneiform magnum and large metatarsal bones.

Subcutaneous firing as recommended by some Continental veterinarians has no obvious advantage. Cunean tenotomy often gives good results, but the operation in cases where exostosis is marked usually resolves itself into subcutaneous scarification of the enlargement in which the cunean tendon is practically buried. Hunting reported about 80 per cent of recoveries following the operation. He considered that section of the tendon relieved the parts beneath of much pressure, and that when healing occurred there would be adhesion throughout the whole of the bursa and the pull would be on the part most anteriorly attached. In other words, the pressure would be less on the spavin afterwards than it was before, even if one only divided the tendon.

Cunean tenotomy may be performed with the patient in the recumbent position, and under anæsthesia. The upper hind limb is secured forward. The inner surface of the affected hock having been prepared for operation, an incision is made at the point shown in Fig. 154, exposing the cunean tendon, which is then divided. A portion of the tendon may be excised and the surface of the spavin scarified. The wound of the skin is then sutured and protected by an antiseptic adhesive.

A variation of this process is the insertion of a plug of gauze or tow, saturated with an irritant fluid, such as a spirituous solution of perchloride of mercury subcutaneously over the seat of the spavin. This is left in position for twenty-four or forty-eight hours and is followed by swelling and suppuration. It is in reality a modified seton and a form of counter-irritation.

Setons are occasionally employed, but possess no advantages and many disadvantages.

Neurectomy of the anterior tibial nerve followed by section of the posterior nerve, when improvement does not follow the first operation, has been recommended. This is usually unsuccessful, and in some cases paralysis of the extensor pedis results with knuckling of the fetlock, and occasionally the horse may walk on the front of the fetlock-joint.

Shoeing with raised heels and shortening the toe often improves the action and is useful in chronic cases. In recent acute cases it is liable to increase the tendency to contraction of the tendons and to bring about permanent flexion of the hock.

Bony enlargements of the outer surface of the hock more usually result from periostitis than from true ostitis, though cases of true external spavin associated with articular disease are occasionally seen. In most cases lameness is only coincident with the inflammatory period. Exostosis is chiefly confined to the head of the small metatarsal bone, though sometimes the cuboid is involved. In some instances lameness is not noticeable. When treatment is necessary point-firing followed by blistering and a run at grass gives the best result.

Chronic Synovitis of the True Hock-joint. Bog-spavin.—The term "bog-spavin" indicates a chronic distension of the synovial capsule of the true hock-joint.

Causes.—Without doubt defective conformation of the hock plays the most important part in the production of bog-spavin. The type most commonly affected is the upright hock in which there is a considerably increased area of the anterior capsular ligament unprotected, as compared with that in the case of a well-formed hock. Working animals of this sort at an early age is almost certain to produce the disorder.

Probably strain as in covering or overwork may produce bog-spavin, even in old horses, though in most cases weakness of structure is primarily responsible.

Possibly the excessive secretion of synovia is a provision of nature to protect the articular surfaces of badly formed joints. At any rate it is quite usual for hocks affected in this way to remain workably sound as long as the majority of better-looking ones. Lameness is not at all a common symptom. When it does occur it is usually the result of excessive distension of the synovial capsule, which mechanically prevents full flexion of the hock-joint, or else it arises from acute synovitis, which will presently be described and is quite distinct from bog-spavin.

The distended synovial capsule causes a tense fluctuating swelling on the antero-internal aspect of the hock, and when the tension is very great or when pressure is put upon the enlargement two smaller dilatations on the lateral surfaces of the hock may also be seen to be filled. These are termed " articular thoroughpins."

Treatment.—Unless lameness is present, little benefit will be derived from treatment. The excessive secretion of synovia is probably advantageous in a badly formed joint, as it not only ensures thorough lubrication but acts as a buffer, warding off the effects of concussion. Moreover, hocks thus affected usually remain sound (from the view of utility) for many years. When lameness is present from over-distension, line-firing and blistering may cause a reduction by contracting the skin and exerting pressure upon the swelling. Spring trusses are of little practical value, as the reduction in size is usually only temporary.

Aseptic aspiration of the contents and subsequent injection of a 1 per cent solution of iodine dissolved by the aid of iodide of potash, or a 1 in 1000 solution of hydrarg. perchlorid., has often given good results. Occasionally the synovia may be turbid and flaky and it may be impossible for it to flow through the needle. The site of the puncture should be closed with iodoform collodion and a biniodide blister immediately applied, or a pressure bandage maintained in position by pitch or glue may be substituted.

Another method is acupuncture performed by puncturing the bog-spavin with four or five needles pushed through a cork so that their pointed ends protrude about three-quarters of an inch. The operation is repeated in a week and the parts are well rubbed with iodine ointment and covered by a pressure bandage.

Acute Synovitis of the Hock-joint.—This condition may be caused by severe wrenching of the joint, as a result of infection from without, or from the navel in foals or after strangles, or it may arise from acute rheumatic changes.

Symptoms.—The limb is carried and the foot swung clear of the ground in a forward direction. The hock is much swollen, particularly over the antero-internal surface, hot to the touch and very painful. Pressure upon the distended capsular ligament causes acute pain with rapid abduction and lifting of the limb; the animal may almost fall in the process.

In severe cases laminitis may ensue in the opposite foot. There is often constitutional disturbance, fever, loss of appetite, and rapid wasting.

Prognosis.—As changes usually occur somewhat rapidly in the articular cartilage of the astragalus and tibia, in the form of deep grooves with thickening and even calcification of the synovial membrane and increased secretion of synovia, which becomes turbid and occasionally purulent, the condition is always a grave one. Sometimes the joint ruptures under the excessive distension of its capsule. Occasionally resolution occurs and the animal may work sound or almost so for some months, when lameness will again appear. Old-standing cases are hopeless owing to the joint lesions developed.

Treatment.—In the early stages rest in a level field or in slings and warm fomentation followed by friction with a mild liniment are beneficial. The hock should subsequently be wrapped in warm flannel.

Later line-firing followed by a mixed biniodide and cantharides blister and a prolonged run at grass may improve matters. Occasionally shoeing with calkins may diminish the lameness.

Fracture of the Os Calcis.—*Causes.*—Direct injury by blows or kicks, by the horse lashing out, or by sudden slipping, as during rising or falling with the hock flexed. Fracture is then caused by the pull of the tendo Achillis. In young animals fracture may occur at the summit of the bone before complete ossification has occurred.

Symptoms resemble those of rupture of the tendo Achillis, but there is usually apparent flattening of the point of the hock. No weight can be borne on the limb, which collapses at each step. In walking, all the joints are flexed and the lower portion of the limb may jerk upwards and forwards (excessive flexion of the hock-joint), or they may rest on the ground through dropping of the hock, owing to lack of support.

Prognosis.—Recovery may occur in two to three months when the fragments can be kept in contact. Compound fractures are seldom curable. In most cases of complete fracture it is impossible to maintain the bones in contact, as every movement of the gastrocnemius and perforatus causes displacement. Laminitis is a frequent sequel.

Treatment.—A high-heeled shoe should be applied and the horse placed in slings. Tightly rolled wedges of tow should then be applied at the sides and back of the calcis after reposition has been effected, and the whole surrounded by a series of pitch bandages. The hock should be kept extended as far as possible.

Fracture of the other bones may often be suspected, but exact diagnosis is difficult. Fracture of the astragalus is scarcely distinguishable from acute arthritis of the astragalo-tibial joint.

Treatment when carried out must aim at anchylosis.

R. H. S.

DISEASES OF THE FEET

Canker.—Looking upon the integument of the foot as a modified portion of the skin, canker may be defined as a chronic hypertrophic moist eczematous dermatitis, a definition which answers the description of the disease in its most typical form. The condition is not so common now as formerly, owing apparently to the advance of hygiene in connection with the care of horses, for it is generally admitted that the affection is greatly favoured by dirty surroundings, keeping horses in dirty, ill-drained stables, with the feet constantly in contact with litter soiled with fæces and saturated with urine, which macerates the horn and exposes the sensitive tissues to injury and infection which may be a predisposing if it is not an exciting cause of the lesions. This theory is also borne out by the fact that it is the hind feet which are most commonly affected. Marshy localities seem to have a determining influence on the malady, as it is certainly more common in them than in upland districts. It is more common in the East Midlands of England than in other parts of the country. Lymphatic temperament is a predisposing cause of canker, as it occurs most frequently in coarse-bred, phlegmatic subjects. It is commonly believed that there is a hereditary tendency to the disease, and it is looked upon by many as a local manifestation of a constitutional affection like other skin eruptions. The disease presents features which are suggestive of its being of an infectious nature, but so far no specific organism has been found in connection with it. Spirochætes and various forms of bacteria have been found in the lesions, but the disease could never be set up experimentally by any of them.

Canker may remain localized in one foot for a long time and then attack successively the other feet, and after being apparently cured it may suddenly break out again. It begins either as a sort of grease or moist eczema in the skin of the back of the pastern or beneath the horn.

In the former case the affection gradually encroaches on the sub-corneal tissue, whilst in the latter case it commences insidiously and may remain unsuspected for a long time until the separated horn is removed with the farrier's knife or is worn by use. It is the middle lacuna or cleft of the frog which first shows symptoms of the disease as a rule, the affection spreading from there with more or less rapidity beneath the branches of the frog to the lateral lacunæ and thence to the sole, from which it may extend under the wall to the coronet.

Symptoms.—When a considerable area of the foot is involved and the disease is well established the symptoms are very characteristic. The horn overlying the affected part is separated (underrun), more or less ragged, and sodden with moisture, having the appearance in the case of white horn of having been soaked in oil. In an advanced case the horn is absent, and the lesion of the sensitive tissues is exposed. They appear to be affected with chronic inflammation, being covered with a whitish caseous exudation having a very fœtid odour, and showing in places vegetations or hypertrophied papillæ or finger-like processes, which in old-standing lesions may be capped with horn constituting what are known as ergots, and which have been likened to the pads of a toad, this accounting for the French name for the disease, viz. crapaud. The foul-smelling caseous material also forms between the ergots and vegetations. There is evidently no acute inflammation as a rule, because lameness is frequently absent even in a well-marked form of the affection, and when it is present it may be the result of a contusion of the exposed sensitive structures. In bad cases where the os pedis is exposed, either as a result of the disease or injudicious treatment of it, the lameness is very pronounced, and when the laminæ are involved it may be well marked.

Diagnosis is generally easy. The appearance of the lesion is diagnostic, viz. : the underrun and sodden horn, the discharge, the vegetations, the ergots, and the very penetrating, offensive odour. Wherever the horn is adherent the disease is absent.

Prognosis depends on the extent of the disease and the number of feet affected. It has no tendency to undergo spontaneous cure; on the contrary it is progressive in its course. Except treatment is carried out with great pains and very thorough measures are adopted, it will fail to have the desired effect. Sometimes when it is almost cured discontinuing the treatment causes it to break out afresh. When all the feet are badly affected it is hardly worth treating.

Nevertheless, when the malady is not too extensive or far gone, does not extend beneath the wall, and the os pedis is not exposed, proper treatment generally effects a cure within an average period of six weeks, and during two or more weeks of this time the horse may be working.

Treatment.—The exact cause not being known, the surgeon is at the disadvantage of not being able to remove it, but he can avail himself of his knowledge of the admitted predisposing causes to avoid them as far as possible in combating the affection. Experience has shown that the principles of treatment which have given the best results are as follows :

(*a*) After removing the loose horn, thoroughly cleansing and disinfecting the affected foot by enveloping it in antiseptic compresses for twenty-four hours, excise the ergots and vegetations when present.

(*b*) Apply to the affected part a caustic, an astringent, or merely an antiseptic according to the nature of the lesion.

(*c*) Exert great pressure on the affected region by means of twisted pledgets of tow firmly compressed by the aid of a metal sole fixed to the shoe, or by strips of hoop-iron inserted between the shoe and the hoof.

(*d*) Attend to the general health of the patient, and prescribe arsenic or one of its preparations to be administered daily for a while at intervals until the disease is cured.

(1) Removal of the vegetations and ergots is necessary to bring the affected part on a level with the normal tissues. Care must be taken in so doing not to expose the pedal bone, and in operating on the frog to follow its configuration and not mutilate it unnecessarily.

It is also advisable to thin the normal horn for a short distance beyond the periphery of the affected region to facilitate equalizing the distribution of the pressure, and to prevent irritation of the sensitive tissues by the edges of the horn.

(2) Nearly all the common caustic and astringent drugs in the pharmacopœia have been recommended by different authorities for application to the diseased surface. Probably any one of these is as efficacious as another, success depending rather upon the method of application than upon the agent employed. The following applications have been lauded by different practitioners :

Nitric acid, sulphuric acid, pure or mixed with alum (Plassis paste) ; hydrochloric acid, butyr of antimony, carbolic acid, acetate of copper, sulphate of copper, creosote, salicylic acid, formalin, Czerny's solution (arsenic 1, methylated spirit 40, water 40), nitrate of lead, a mixture of carbide of calcium, iodoform, acetate of copper and starch, a mixture of the three sulphates of copper, zinc, and iron, and powdered chinosol, etc.

With each one of the foregoing *topics* success has been obtained, while failure has also been recorded, and one can hardly be said to possess more virtues than *another*.

The hot iron is also strongly recommended by many veterinary surgeons as having an excellent effect when its edge is passed lightly over the affected region before applying an astringent dressing, such as the three sulphates, as advised by Malcolm and others. After first applying a caustic to slough away the diseased surface, apply an antiseptic powder before putting on the tow, such as iodoform or a mixture of it with starch and oxide of zinc or powdered chinosol. As the case progresses favourably, avoid the frequent use of caustics and depend chiefly on antiseptic powder associated with pressure.

(3) In arranging for pressure take precautions to have it firm and equally distributed.

The pledgets of tow should be in the form of hard cords of assorted sizes for adaptation to the different parts of the foot, care being taken that the lacunæ of the frog are well packed with rolls of corresponding shape and size. Apply a series of large thick pledgets on the outside. Bring pressure on the tow either by means of pieces of hoop-iron bent in the form of a bow to permit of their ends being introduced beneath the foot-surface of the shoe, where they are driven in by striking the convexity with a hammer, or by a metal sole driven in from behind between the shoe and the hoof, or screwed on to the sole of the shoe. The strips of iron are more satisfactory than a metal sole.

In order to carry out these measures thoroughly it is generally necessary to have the horse fixed in stocks or cast, and when vegetations have to be removed, chloroform anæsthesia is advisable. The case should be dressed daily for a while until considerable improvement occurs, when the intervals between dressings are gradually extended until once per week proves sufficient, the surgeon being guided by the state of the lesion. If lameness be absent it is an advantage to keep the horse working. During the early stages of the treatment the severity of the dressings, and the great pressure exerted on the exposed sensitive tissues, may cause some lameness and necessitate keeping the horse idle for a while.

Working on dry clay favours recovery, and may be sufficient of itself to effect it should it be possible to continue it for a long period.

(4) The administration of arsenic has long been known as beneficial in the treatment of the affection, and comparatively recently the late Major Holmes, A.V.C., found, when treating surra in India with a course of arsenic, that those animals which happened to be affected with canker at the same time became cured of the latter disease as a result of the treatment. In the United Kingdom, however, it has not proved a specific.

Quittor.—Quittor is a sinus or suppurating passage opening on the coronet at the level of the lateral cartilage, and due to necrosis of this structure.

Etiology.—The cause of the condition may be :

(1) *Injury and infection* of the cartilage such as may result from a tread on the coronet causing a contused or punctured open wound, which is more likely to occur when the shoes have calkins, and especially when the latter are sharpened for frost.

(2) *Necrosis of the skin* in the affected region resulting from the effects of cold associated with dust and bacterial infection spreading subsequently to the cartilage.

(3) *A suppurating corn or sand-crack or lesion resulting from a punctured foot or a picked-up nail* from which infection extends to the cartilage.

The cartilage may be involved in an open wound without undergoing necrosis, but the latter is very likely to ensue owing to the feeble vascularity of the part, making it an easy prey to the organisms invading the wound. Once necrosis begins in the cartilage it has a great tendency gradually to affect the whole structure on account of its poor blood supply, and the close continuity of the dead and healthy parts. Spontaneous separation of the necrotic piece of cartilage may, however, take place, and should it escape with the discharge natural cure will result. This is much more likely to occur posteriorly than anteriorly, because in the former situation the cartilage is more interspersed with fibrous tissue, separating it into islets which are comparatively easily detached.

Symptoms.—The symptoms are those of a sinus with a combination of more or less acute and chronic inflammation in its vicinity.

The inflammatory swelling varies in size according to the extent of the disease. It may correspond only to a part or to the whole of the cartilage. It projects beyond the level of the wall of the hoof, and bulges it outwards at the coronet. It generally begins at the heel and spreads thence forwards. It is more or less painful on manipulation, the pain being usually most marked when the antero-inferior extremity of the cartilage is affected, and being always very acute when an abscess is being formed.

When the skin is unpigmented the redness due to the inflammation is noticeable, and varies in intensity according to the acuteness of the condition. The sinus usually has only one orifice on the coronet, but in rare cases it has two or three openings here. When there are more than one opening they all communicate with the necrotic centre. The entrance to the sinus may be only large enough to admit a probe, and is often obscured by a mass of granulations or proud flesh.

It may be infundibuliform in shape, and is constantly weeping or discharging a greyish purulent fluid which may be streaked with blood due to rupture of some of the capillaries in the granulation tissue of the part. The calibre of the sinus varies in different cases. It may be branched. Its course is usually oblique, a common direction being downwards and forwards, terminating on the wing of the os pedis in well-established cases.

When the condition is a complication of a corn or sand-crack there may be a plantar or parietal sinus respectively in addition to that on the coronet, or rarely the latter may be absent until the disease has been in existence for a considerable time. There may be one or more cicatrices on the skin over the swelling representing orifices that have healed after the pus had gained exit in a new situation through the medium of a secondary abscess. Afterwards some horizontal rings or rugæ form on the wall beneath the affected part, due to the latter interfering with the secretory function of the coronary band in this region. By noticing the depth to which these extend, and remembering that the horn grows at the rate of $\frac{1}{4}$ inch to $\frac{3}{8}$ inch per month, one can estimate approximately the duration of the affection. The degree of lameness varies according to the nature of the lesion. When the superior or posterior part of the cartilage only is affected it is slight or absent, but when the disease is in the vicinity of the antero-lateral ligament, or when the latter is involved, it is very marked. If arthritis supervene its symptoms will be manifested.

Complications.—The complications which may arise are :

1. *Necrosis of the antero-lateral ligament,* which may in consequence become ulcerated through exposing the joint to infection.

2. Septic arthritis resulting from No. 1, or from perforation of the cul-de-sac of the synovial membrane of the articulation where it comes in contact with the antero-internal aspect of the cartilage, allowing infection of the joint.

3. *Necrosis of the Os Pedis.*—Infection may spread from the cartilage to the os pedis, causing necrosis thereof. If this occur near the articular surface septic arthritis may supervene.

4. *Necrosis of the Sensitive Laminæ or Plantar Cushion or Plantar Aponeurosis, the latter being rare.*—The plantar aponeurosis is more likely to be affected when the quittor results from a suppurating corn than when it arises in some other way.

5. *An abscess* which may form at the inner side of the cartilage and burst on the skin.

6. *Gangrene of the skin* over the affected region.

Diagnosis is generally easy on account of the circumscribed swelling at the level of the cartilage and the presence of the sinus. Wounds of the coronet and abscesses not involving the cartilage heal easily.

Prognosis.—Quittor is an obstinate affection, having practically no tendency to spontaneous cure, and often resisting ordinary therapeutic measures for months. The condition is not so serious when confined to the superior or posterior part of the cartilage as already explained. Operative treatment is nearly always successful, but it may be followed by some deformity of the hoof, or by hyperæsthesia of the cicatrix.

Great depth of the sinus and a copious discharge of pus are unfavourable signs.

The presence of complications makes the affection more serious. The lesion is more easily dealt with in the hind limb, because the cartilage there is less dense and more vascular than in the fore limb.

Treatment.—The principles of treatment are those of a sinus, and comprise measures for the removal of the necrotic tissue, the provision of drainage for the pus, and the destruction of bacteria, with the object of causing a healthy granulating wound which will undergo cicatrization and bring about recovery.

The method of procedure may be :

1. *The injection of an antiseptic liquid* by means of a syringe with a long narrow nozzle into the depth of the sinus two or three times daily in order to pluck out loose necrotic tissue, arrest the development of bacteria, render the lesion sterile, and thus allow healing to take place. This may succeed in a recent case where the sinus is not deep and the necrotic cartilage is near the surface, that is, affecting its upper or posterior border. Otherwise it is generally a failure, the affected part being too deep-seated to be effectively acted upon by the injection, or to permit of the escape of necrotic material. To obtain the best results from it, it is necessary to enlarge the entrance to the sinus in order to facilitate reaching the affected area with the germicidal agent. The patient resents this treatment, and it is generally disappointing in its results.

2. *The Injection of a Caustic Liquid.*—This is more effective than No. 1, the agent being a more powerful germicide and having an escharotic effect which brings about separation of necrotic tissue and removal of the lining of the sinus, thereby opening it up and facilitating the escape of necrotic debris and purulent matter. It is carried out in the same way as No. 1, and when thoroughly done it often effects a cure within two or three weeks, the discharge becoming gradually less and the inflammation and lameness disappearing by degrees. It is, however, by no means infallible, and is contraindicated when the sinus is deep and anteriorly situated on account of the risk of sloughing of the thin layer of tissue protecting the joint in this region and causing arthritis. Various preparations have been used with more or less success, including the following :

(1) Corrosive sublimate 1, alcohol 10; (2) corrosive sublimate 17, methylated spirit 140, hydrochloric acid 2-4, acetate of lead 34; (3) sulphate of zinc 5-10 per cent solution; (4) chloride of zinc 5-10 per cent. The result depends not so much on the agent used as the manner in which it is applied to ensure its reaching the affected part.

3. *The use of solid caustics*, that is, the introduction into the bottom of the sinus of a caustic in the form of a powder or pencil or plug, the one most commonly and successfully employed being corrosive sublimate. To allow of its deep insertion it is necessary to open up the sinus with a knife. The powder may be enveloped in blotting-paper to enable it to be passed into the sinus. It has the effect of causing an eschar or slough, which comes away in the course of ten or fifteen days, carrying with it the diseased cartilage, in favourable cases, and leaving a gaping, granulating wound which rapidly cicatrizes. A second application of the caustic may be necessary in some cases where a portion of the necrotic cartilage remains inside after the separation of the eschar.

This procedure is spoken of as the "coring-out" treatment on account of the formation of the eschar or "core." It often fails owing to the agent employed not "touching the spot." Used in the vicinity of the joint it may lead to opening of the latter with fatal consequences.

4. *The Use of the Thermo-cautery.*—A red-hot iron rapidly plunged into the lowest part of the sinus and rapidly withdrawn has often proved effective in sloughing out its lining, including the necrotic cartilage, while at the same time it acts as a powerful bactericide, destroying all the microbes with which it comes in contact. Its use is dangerous in the vicinity of the joint on account of the risk of penetrating it with the instrument, which must be inserted blindly, without any reliable guide as to the exact course which it takes or the depth to which it reaches. If not inserted deeply it will not have the desired effect.

5. *A combination of Nos.* 3 *and* 4 is often employed, and proves more successful than either alone. All these caustic applications cause severe inflammation, rendering interference with the part very painful and provocative of resentment by the horse, which may become very restive and difficult to control.

6. *The use of a seton* or piece of tape passed into the sinus above and brought out through the wall of the hoof at the level of the bottom of the passage to ensure drainage through the counter opening, and to enable a caustic applied on the seton to be brought into contact with all

parts of the lesion, a method of treatment which is often efficacious.

7. *Extirpation of the Cartilage.*—The steps of the extirpation are as follows :

(1) *Preparation of the Foot.*—The day before operation remove the shoe, thoroughly clean and scrape the entire hoof, clip the hair up to the fetlock, wash the digit with soap and water, bathe it with an antiseptic lotion, and envelop the foot in a moist antiseptic compress covered with a boot.

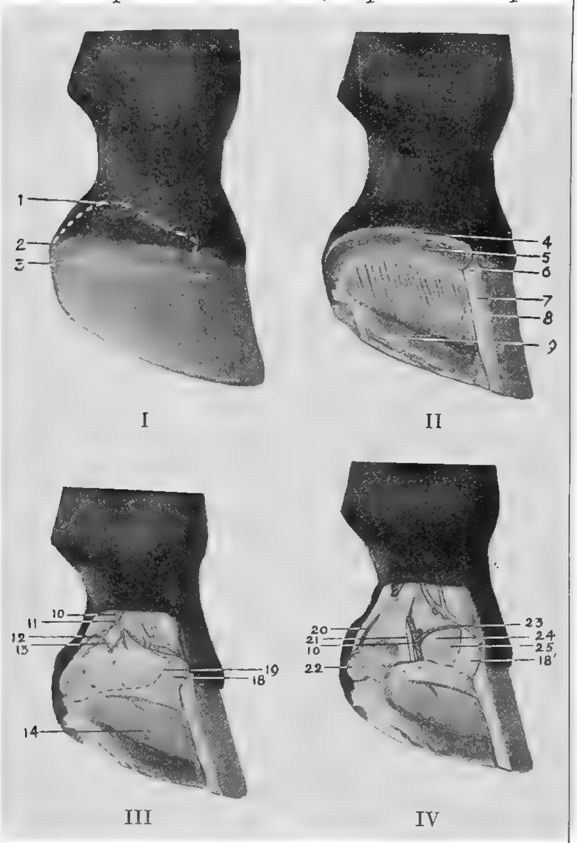

FIG. 155.—Foot (side view).

I.—SURFACE ANATOMY.—1, Upper border of the lateral cartilage marked by a dotted line; 2, coronet; 3, line indicating incision for removal of the lateral cartilage.

II.—SUBCUTANEOUS DISSECTION.—4, Perioplic ring; 5, coronary cushion; 6, cutigeral groove; 7, vertical section of the wall of hoof; 8, sensitive laminæ; 9, horny frog and sole.

III.—DEEP DISSECTION.—18, Antero-lateral ligament of the corono-pedal joint covered partly with fascia and partly with lateral cartilage; 19, outline of the lateral cartilage marked by a dotted line along its anterior and inferior borders.

IV.—DEEPER DISSECTION.—18′, Antero-lateral ligament of corono-pedal joint dissected out; 20, artery to the plantar cushion; 21, posterior digital nerve; 22, plantar cushion; 23, artery of the coronary circle; 24, postero-lateral ligament of the corono-pedal joint; 25, cul-de-sac of the synovial membrane of the same joint.

(2) *Thinning or Removal of the Horn of the Wall in the Affected Region.*—Thin the wall beneath the lesion until the sensitive laminæ are reached, from the anterior to the posterior extremity of the cartilage above, and over a smaller area below, so that the thinned surface is considerably greater in its upper than in its lower part. Instead of thinning the horn it may be stripped off as follows : make a groove through the wall obliquely downwards and backwards from the anterior extremity of the cartilage to the plantar aspect of the hoof ; make another groove parallel to this at the heel ; join the two grooves by a third one at the white line. Seize the lower end of the isolated piece of horn with a pincers, and, pulling forcibly upwards, strip it from the sensitive tissues.

(3) *Incision of the Keratogenous Membrane.*—Apply a tourniquet round the pastern to prevent hæmorrhage during the operation. Make a linear incision between the coronary band and the laminæ, extending from the anterior to the posterior extremity of the cartilage going through the keratogenous membrane.

(4) *Separation of the Coronary Band and the Skin from the Outer Surface of the Cartilage.*—Inserting a knife through the incision just described, separate the coronary band from the underlying tissue throughout the entire length of the wound. Insert a retractor beneath the separated band and have it held up by an assistant. By means of a double-edged sage knife separate the skin from the whole of the outer surface of the cartilage. Having thoroughly exposed the latter, introduce the blade of one of the sage knives (right or left) to the inner aspect of the cartilage behind, and, cutting vigorously from within outwards, remove the posterior part of the structure. Excise the anterior portion by successive slices so as to avoid opening the joint by cutting into the process of synovial membrane which is in contact with the inner face of the cartilage in front. Further to guard against this accident, have the foot held in extension when operating in this region in order to stretch the membrane and keep it out of the way of the knife.

To remove the extreme anterior part of the cartilage in contact with the bone, or to scrape the latter when diseased, use the curette or sharp spoon, scraping from within outwards to avoid entering the joint. Irrigate the wound with an antiseptic solution. If the antero-lateral ligament is altered on its surface from superficial necrosis swab it with tincture of iodine. Take off the tourniquet, and if bleeding vessels can be recognized secure them by torsion or ligation. Apply an antiseptic powder to the wound, cover the seat of operation with a large antiseptic pad of gauze, cotton-wool, or tow, kept in position by a bandage. Put on a leather boot enclosing the whole foot, or use an improvized boot of plaited straw, formed by uniting two large plaits of straw at their centres at right angles to each other, the foot being placed at their centre and the ends applied longitudinally on the limb, and fixed there by a soft rope or a bandage. The boot may be dispensed with, and the ordinary shoe and a leather or metal sole applied.

Renew the dressing on the following day and do so daily for a while, after which an occasional renewal of the dressing will be sufficient. If the bleeding is practically nil the original dressing may be left on for two or three weeks, when the wound may be almost healed. As new horn forms on the coronary band keep it pared until the wound is healed; otherwise it may interfere with the drainage from the wound, or encroach on the latter, wounding the delicate granulations and perhaps giving rise to an abscess beneath the flap of skin.

Results of Operation.—If thoroughly performed, and the wound is protected from infection, cure will be effected within five weeks, when the horse is usually sound and fit to do light work if carefully shod so as to have no bearing on the hoof in the vicinity of the affected region, which should be covered with a dressing of tar, tow, and a short bandage, the latter also being smeared with tar on the outside. A leather sole is advisable as a protection against dirt, and a three-quarter bar shoe is generally suitable. As a rule, once the horn has grown down to the ground no sign of the lesion or operation is visible, but occasionally a space persists between the laminal and coronary horn in which foreign matter may accumulate and cause lameness from pressure on the sensitive tissues.

The remedy for this condition is to thin or pare away the outer layer of horn and remove any dirt or foreign material that has accumulated beneath it, and then apply a dressing of tar and tow to prevent its recurrence.

Rarely lameness persists from hyperæsthesia in the cicatrix, for which needle-point firing of the coronet in the affected region may be successful. If not, neurectomy will be necessary.

Modifications of Operation.—1. *Bayer's Operation.*—Make a semicircular groove in the wall extending from the anterior to the posterior extremity of the cartilage, with its convexity downwards and the summit of the latter about 1½ inch above the plantar border of the hoof. Strip off the isolated piece of horn. About ½ inch inside the periphery of the exposed surface make a semicircular incision going through the skin, for a short distance above the coronet, the coronary cushion, and the podophyllous membrane.

Reflect the semicircular flap thus marked out, thereby thoroughly exposing the cartilage. Remove the latter as described, replace the flap in position, and suture the cut edges of skin and laminal membrane and dress as before. The advantage of this method is that it greatly facilitates the excision of the cartilage, while its objectionable feature is that it involves cutting the coronary band in two places, causing two false quarters or defects in the wall, which, however, are very slight and of no great consequence.

2. *Divide the Flap by a Mesial Incision.*—Proceed as in the original operation until the cartilage is laid bare. Then divide the flap by a mesial incision into an anterior and a posterior half and reflect them to expedite the removal of the cartilages. Unite the two parts of the flap by sutures, pins being the most suitable for the purpose. The sutures do not always succeed in keeping the cut edges in apposition, and they may then overlap, causing deformity. A false quarter is formed opposite the point of section of the coronary band.

3. *Operate from above the Coronary Band.*—Remove an elliptical or circular piece of skin surrounding the orifice of the sinus, and dissect the skin from the cartilage for some distance beyond this point. Following the sinus to its depth, ascertained by the use of the probe, remove all the necrotic cartilage by means of the curette and fill up the cavity with a reliable antiseptic powder, such as a mixture of boric acid and iodoform, or potass. permang. 1 and boric acid 10, or biniodide of mercury.

Acute Laminitis.—Acute inflammation of the sensitive laminæ may occur in all the feet, or in both fore or both hind feet, or in one foot, but never in two diagonal or two lateral feet.

Etiology.—This comprises: 1. Predisposing causes; 2. Exciting causes.

1. *Predisposing Causes.*—These include:

(*a*) *Heavy body weight,* big heavy horses or those whose bodies seem too heavy for their limbs, like fat ponies and idle stallions, being likely subjects.

(*b*) *Unfit Condition.*—Horses being left in the stable for days without or with insufficient exercise, and then made to go a long journey, often become affected at the end of the latter. Young horses put to work for the first time are apt to suffer from the disease if made to do more work than their immature condition is fitted to bear.

(*c*) *Plethora.*—Plethoric subjects are more susceptible than those in moderate hard condition.

(*d*) *Hot weather* favours the onset of the malady.

(*e*) *Abnormal Conformation of the Feet.*—Flat spreading feet and narrow contracted feet are more often attacked than normal feet.

2. *Exciting Causes.*—The exciting causes may be:

(*a*) *Errors in diet,* such as overfeeding, especially on nitrogenous food—for example, oats, rye, barley, wheat, peas, and beans; or taking a big feed of any stuff to which the animal is not accustomed. Green cereals partaken of in undue quantity may give rise to it, viz. lucerne, sainfoin, and vetches, particularly when recently gathered. Horses eating too much of the gleanings in the harvest-time sometimes become affected.

(*b*) *Overwork.*—Horses doing long fatiguing journeys by road frequently become affected in consequence of the prolonged concussion on the feet. When (*a*) and (*b*) are associated the condition is still more likely to supervene.

(*c*) *Exposure to cold* and damp has been blamed as a cause on the Continent, but in this country it does not seem to have a predisposing or determining effect on the disease. When it does appear under these circumstances it seems to be of a rheumatoid nature.

(*d*) *Excessive weight on one foot,* owing to the presence of a painful lesion in the other limb, may cause laminitis in the former.

(*e*) *Toxœmia,* resulting from an infectious disease such as purpura, pneumonia, or metritis, or from the absorption of toxins from the alimentary tract following an attack of colic. It is a very common complication of simple metritis in the mare.

Symptoms.—The symptoms vary according as the disease affects one, two, or four feet and according to the acuteness of the attack. They are general and local.

General Symptoms.—The general symptoms are those of pain and fever.

Pain is evinced by the attitude and expression of the patient.

When the two fore feet or all the feet are affected the horse stands with the fore limbs in front of the body and the hind limbs well under it, his object being to let most of the weight fall on the heels. If the hind limbs only are affected he keeps all the feet under the body to make the fore feet bear most of the weight and to make the heels of the hind feet bear most of the pressure. The animal stands persistently and is very unwilling to move, and when forced to do so groans. When the patient is recumbent he lies stretched out and is very reluctant to rise, being afraid of the pain caused by putting weight on the feet.

During progression the gait is of a peculiar crouching character, the heels being put to the ground first and the feet lifted quickly as if they were burnt by contact with the earth. The subject trembles with pain. When only one foot is affected weight is alternately placed on it and the other foot which is always suffering from some other painful lesion. The expression is anxious and indicative of suffering.

Fever is manifested by the usual symptoms of febrile disturbance.

The temperature is 103° to 106° F., the pulse is frequent and strong in the early stages of the affection before exhaustion supervenes, when it becomes weak. It may be 70 to 120 per minute. The respirations are accelerated, due chiefly to the pain.

The conjunctiva is injected.

The local symptoms are those of more or less acute inflammation. Abnormal heat is readily detected by placing the hand on the hoof, and throbbing can be felt in the digital arteries. Pain is evinced on the slightest percussion of the foot by the animal snatching it smartly from the ground.

In the course of four to twelve days these symptoms usually subside and resolution sets in, the horse gradually regaining his normal condition. Sometimes, however, they become intensified due to hæmorrhage or exudation taking place beneath the horn. Hæmorrhage is due to rupture of the sensitive laminæ as the result of severe congestion and the drag caused upon them by the downward pressure of the os pedis under the body weight. The blood accumulates between the wall and the os pedis, and its pressure on the sensitive structure causes excruciating agony, the patient lying prostrate, bathed in sweat, and groaning with pain. Occasionally some of the blood escapes at the coronet through a separation between the horn and the coronary band.

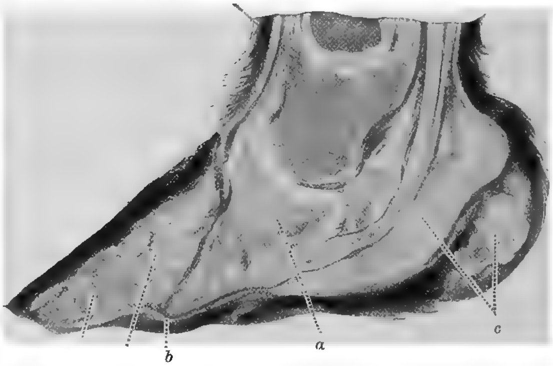

Fig. 156.—Section of foot affected with acute laminitis.

a, Displaced os pedis; *b*, edge of bone resting on horny sole; *c*, plantar cushion and frog.

Death soon follows in a bad case of this kind.

The collection of inflammatory exudate in the same situation causes similar symptoms, and some of it may ooze out between hair and hoof. Gangrene may supervene on one of the latter conditions, due to infection gaining entrance to the inflamed region. Its onset is characterized by suppression of the intense symptoms of pain and inflammation, giving the impression that the patient is better, but the cold sweat which bedews the body, the feeble, frequent, or imperceptible pulse, and the cold extremities indicate that death is nigh.

Diagnosis.—Diagnosis is generally easy after careful examination of the case, which prevents the condition being confounded with tetanus, coronitis, sprained back, or rheumatism.

Prognosis.—The prognosis varies according to the nature of the attack. It is more serious when all the feet are affected than when two or only one foot is involved. The condition is generally more grave in horses that have been doing fast work than in those that have been engaged in slow work, in highly-strung nervous animals than in lymphatic subjects, and in big than in small horses.

If a cure is not obtained within fourteen days the affection is apt to become chronic, or still more acute and to terminate in death. When the symptoms are alarming in the beginning the prognosis is generally gloomy.

Prevention consists in avoiding the causes mentioned and in keeping animals under good hygienic conditions.

Treatment should be prompt and energetic. Its general principles are those recommended for fever and acute local inflammation.

Constitutional Treatment.—This comprises :

1. *Jugular Phlebotomy*.—Removing one to two gallons of blood in a sthenic subject. This has undoubtedly a good effect when promptly performed, soon after the commencement of the attack. The objection to it is the risk of phlebitis.

2. *Purgation*.—Prompt purgation is decidedly beneficial. Consequently the administration of eserine or arecoline hypodermically is indicated on account of its rapid effect. Pilocarpine may be combined with the former. Arecoline is particularly efficacious and is looked upon by some authorities as a specific, its action being so frequently followed by immediate amelioration of the disease. It is not, however, invariably successful.

3. *The administration of febrifuges*, such as tincture of aconite, salicylate of soda, quinine sulphate, spts. ether nit., liq. ammon. acet., or sodium hyposulphite.

Tincture of aconite is probably the most effective febrifuge in the early stages of an acute attack, but neither it nor any of the others has a very striking influence on the course of the disease.

4. *Counter-irritation*.—On the Continent counter-irritation of the upper part of the limbs, the chest, and abdominal walls by rubbing in a rubefacient application is done with the object of causing a deviation of blood thereto from the feet so as to relieve the congestion of the laminæ.

Local Treatment.—Local treatment comprises :

1. *Cold applications* in the form of a foot-bath, moist compresses, or constant irrigation.

The foot-bath may be provided by a stream or pool or by digging a hollow in a clay floor in the stable or in the open, or by a thick bed of sawdust or sand saturated with cold water, the patient being allowed to stand in the bath for the greater part of the day or constantly. Cold swabs applied round the pasterns and overhanging the hoofs may be used in the intervals between the baths, or instead of them, especially when the patient is recumbent. They should be kept cool by frequent application of cold water. Constant irrigation through a perforated rubber bracelet round the limb above the fetlock communicating with a rubber tube from a tank of water above the level of the horse is a very effective means of carrying out this method of treatment. In the winter snow or ice may be procurable for the application of cold and prove more beneficial than water.

2. *Astringent applications* to be used alternately with the cold applications, and including the usual refrigerant lotions such as liquor plumbi subacetatis, white lotion, etc.

3. *Bleeding from the Toe*.—Paring the horn of the sole at the toe and drawing blood from the sensitive tissues in this region has had considerable vogue and is certainly a good method of relieving congestion in the inflamed part, but it has the serious objection that it favours infection therein with its dangerous sequelæ, suppuration and gangrene. If it is done antiseptic precautions are necessary.

4. *Hot Applications*.—Hot poultices or hot moist compresses are favoured by some practitioners, but they are probably not so useful as the cold treatment.

5. *Hypodermic Injection of Adrenalin*.—The hypodermic injection of adrenalin in a dose of twenty to thirty minims diluted with an equal quantity of normal saline solution over each digital artery usually has a marked beneficial effect, causing a rapid fall in the temperature and a decided and prompt improvement in the animal's gait. Nevertheless, it is not an infallible agent for bringing about a cure, and sometimes it is followed by sloughing at the seat of injection.

6. *Hypodermic injection of cocaine* over the plantar nerves, removing sensation for a while from the feet, gives the patient some intervals of relief from pain, allowing him to rest and recover to some extent from the exhaustion caused by suffering, and permits of his being exercised freely with good effect in dispelling the congestion by stimulating the activity of the circulation in the foot.

7. *Bier's Treatment*.—Applying a rubber band over a thin layer of cotton-wool covered with a bandage round the upper part of each affected limb, sufficiently tightly to arrest the venous circulation without stopping the flow of arterial blood, has been done with good effect, the explanation being that the venous congestion causes increased phagocytosis and an out-

pouring of serum containing anti-bodies which act beneficially in counteracting the effects of bacteria and their toxins which may be present at the seat of the lesion.

The band is left in position for two to four hours daily until improvement occurs.

8. *Grooving the hoof* at the junction of the wall and the sole at the toe to permit of the escape of inflammatory exudate.

This has the same objection as bleeding from the toe, viz. opening an avenue for infection of the inflamed part; otherwise it has the good effect of relieving pain.

9. *Ligation of the Digital Artery.*—When the condition is not responding to ordinary measures or persists in a subacute form, ligation of one of the digital arteries is indicated to relieve the congestion in the sensitive laminæ. The artery is easily isolated on the outer aspect of the fetlock, ligatured in two places, and cut between the ligatures. It generally has good results, improvement following immediately after the operation, the inflammation subsiding and the freedom of gait being restored.

Exercise is an important indication recognized by most practitioners as having a marked effect in favouring resolution. It should be continued for twenty minutes to half an hour twice daily on soft ground. If the hoofs are strong the horse may go barefooted or wear ordinary shoes, but if they are affected with dropped soles rocking shoes should be applied, that is, shoes thin at the heels and toe and thick at the quarters with a wide web and well seated on the foot surface.

Diet.—Soft, laxative diet is indicated, as bran and linseed mashes and grass if in season. A little magnesium sulphate and potass nitrate in the drinking water has a febrifuge effect and keeps the excretory organs active.

When pain is very severe a hypodermic or intravenous injection of morphia may be given.

Chronic Laminitis.—Chronic laminitis is a sequel to the acute form, or occurs spontaneously.

Its local characteristics are changes in the form of the foot.

It becomes elongated antero-posteriorly, narrow transversely, and somewhat flattened in front. The heels are higher than normal, and the wall approaches the horizontal direction in the region of the lower part of the toe, whilst in its upper part it is inclined to the vertical direction, so that its central portion appears depressed or constricted. Rings or rugæ form on the wall parallel to the coronet, comparatively widely spaced behind and almost confluent in front. The sole is convex or flat anteriorly, the lateral lacunæ are abnormally deep, more so than in an ordinary flat-foot. The sole may be perforated in front of the frog, exposing the sensitive tissues, which become inflamed, emitting a serous, sanguinolent, or greyish purulent discharge, and may also undergo necrosis. The wall becomes separated from the laminæ in front, receding from the sole at the white line, the inter-space being empty or filled with abnormal horn secreted by the laminæ. The space is widest at the centre of the toe, where it may measure 2-3 inches. When the condition follows the acute form the symptoms of the latter have disappeared, but a certain amount of hyper-sensitiveness persists in the affected feet. The degree of lameness varies. It may be absent, but the gait is always abnormal, being characterized by the horse going decidedly on the heels.

If an antero-posterior section of a chronic laminitic foot be made, the alterations in its conformation will be very apparent.

The wall is thicker than normal, projected forwards at the toe and not parallel to the anterior surface of the os pedis, which is more vertical than usual.

Between the wall and the sensitive laminæ in front the space already alluded to is evident, filled with homogeneous laminal horn or practically vacant, except for a small deposit of horn covering the laminæ. In a recent case there may be osteophytes on the bone, but in an old case it may show some atrophy. The mechanism by which these changes occur is probably as follows:

The sensitive laminæ in front rupture, whilst those at the heels, being much less involved in the inflammatory process, remain intact, and in consequence the os pedis tends to descend in front, under the body weight, and the perforans muscle asserting its superiority over its antagonist, the extensor pedis, causes the bone to swing backwards on the horizontal axis formed by the intact laminæ at the sides, thus bringing the anterior plantar border of the bone to press on the sole, causing it to bulge downwards and become flat or convex. In consequence of this pressure the sensitive sole undergoes atrophy and ceases to secrete horn. When the existing horn becomes worn away perforation takes place. The descent of the os pedis causes stretching and bending of the papillæ on the coronary band, so that the horn formed by them is more vertical than usual, and thicker than normal, on account of their secretory activity being stimulated by this interference.

This accounts for the prominence and upright direction of the horn near the coronet. During progression the horse puts most weight on the heels, thus pushing the separated wall at the toe forwards and making it approach the horizontal direction.

Diagnosis is usually easy, even when the toe is shortened and the rings removed by the rasp, the convexity of the sole, the deep lacunæ, and the space between the wall and sole being characteristic.

Prognosis.—The prognosis is unfavourable, the deformity and abnormal gait persisting. Recurrent attacks of subacute inflammation may supervene, especially after a long journey by road. For a long time the horse affected can only be used at slow work on soft ground.

Treatment.—Treatment comprises dressing of the foot and the application of appropriate shoes. Remove the excess of horn at the toe but spare the horn on the sole, quarters, and heels. Apply a wide-webbed shoe well seated on the foot surface, so as to afford protection to the dropped sole without bearing on it. In order to avoid making the shoe very heavy, to enable it to be well seated a strip of leather may be interposed between the bearing surface of the shoe and the wall, so as to keep the former away from the sole. A leather plate is desirable as a protection to the sole. The horse generally goes best in a long-heeled shoe, that is, one whose heels project well behind those of the hoof, ensuring the posterior part of the foot striking the ground first, thus saving jar to the hypersensitive anterior laminal region. As time goes on the shape of the foot may improve. When the sole is perforated, immerse the foot in an antiseptic bath if inflammation is present, and after it has subsided dress the part with tar and tow and cover the sole with a metal plate fixed between the hoof and the shoe.

Navicular Disease.—Navicular arthritis, or groggy lameness, is a disease due to chronic ostitis of the navicular bone, associated usually with more or less chronic synovitis of the navicular bursa and inflammation of the plantar aponeurosis.

The condition is practically confined to the fore feet, affecting both as a rule. The hind feet are rarely affected. The most notable change in the navicular bone is the presence of ulcers on its tendinous aspect, appearing as outcuts in the cartilage thereon. Osteophytes may also form on this surface, especially near its extremities. The articular aspect remains intact. Owing to the rarefaction of the bone due to the ostitis it becomes weak and brittle, and may fracture under the body weight, especially if the foot is brought forcibly to the ground in an unexpected manner. Adhesion may occur between the bone and the tendon as the result of fibrinous synovitis. The tendon sometimes becomes fibrillated from friction against the roughened posterior surface of the bone.

Etiology.—The real exciting cause of the disease is obscure, but the circumstances under which it most commonly occurs are well known. It is most common in light horses, especially those doing fast work on hard roads, particularly when they are not getting regular exercise but are subjected to work at a rapid pace occasionally, after more or less prolonged rest in the stable. Cart horses are rarely affected. Heredity is believed to be a cause, an hereditary tendency to the malady being believed to exist in certain breeds of horses of the roadster type. The conformation of the foot is looked upon as a factor in the production of the disease, which most commonly occurs in narrow, upright, or contracted feet. The cause in this case may, however, be confounded with the effect, for when the disease has been in existence for some time it tends to produce this conformation.

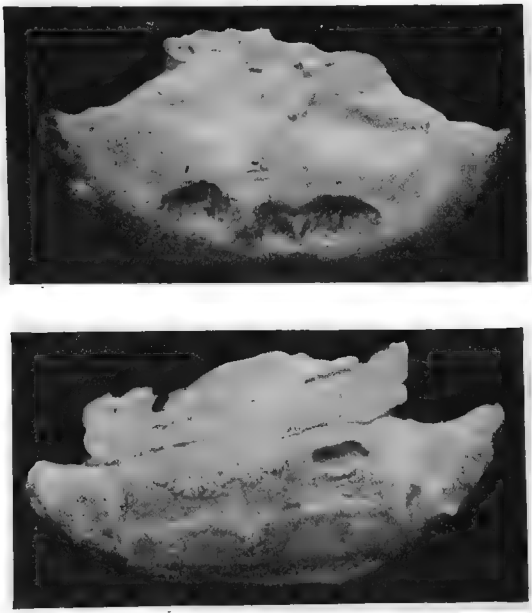

Fig. 157.—Navicular disease.

Navicular disease is usually gradual in its onset and insidious in its appearance, being generally well established before the symptoms are sufficiently well developed to attract the serious attention of the owner. Rarely it appears suddenly as the result of shock on the foot, as may occur during jumping or prancing in a fresh horse, or from making a false step. The cause might be of a toxic nature, resulting from rheumatism or some infectious disease like strangles or influenza.

The absence of frog pressure preventing the action of the anti-concussion mechanism of the foot is undoubtedly a contributing cause of the affection.

Hence a defective system of shoeing, such as the application of thick-heeled shoes or those furnished with calkins, on horses engaged in fast work on hard ground favours the onset of the condition, as do also a long toe and a sloping pastern by throwing excessive weight on the posterior region of the foot.

Symptoms.—The first symptom as a rule to attract attention is the horse pointing his foot when at rest, and as both feet are usually involved he points them alternately. Afterward the animal is observed to go tender occasionally, but when given a rest for a few days he goes sound again. As time passes the lameness becomes decided and is characterized by the subject taking a short stride, going on the toe, with a tendency to stumble when the toe strikes the ground.

The gait is pottering or groggy, and the seat of lameness appears to be the shoulders, on account of the shortened stride. The lameness is most marked on starting after resting for a while, and diminishes with exercise. It is more pronounced on hard than on soft ground, and is intensified by frog pressure and by the use of thin shoes, which have not the same effect in breaking the shock on the feet as thick shoes. When the disease is well established the lameness is continuous. When the horse is turning he screws round on his fore feet instead of lifting them.

The local symptoms comprise the alterations in the form of the foot, which becomes " boxy," that is, contracted and high at the heels, with a very concave sole, deep lateral lacunæ, and an atrophied frog, some swelling in the hollow of the heel due to distension of the navicular bursa, not a constant symptom, some pain on percussion of the frog, not always manifested, and abnormal heat on palpation, only noticeable as a rule after a long journey.

In the rare cases in which the affection is sudden in its appearance the lameness is severe from the beginning.

When the hind foot is affected the horse rests it more than usual, and during progression goes on the toe. If both hind feet are attacked, the lameness is characterized by stiffness of the posterior limbs.

When the condition has been in existence for some time the muscles of the shoulder undergo atrophy and the foot becomes more contracted, both changes being due to the prolonged restricted use of the limb on account of the constant lameness. The disease usually affects horses in their prime, when about seven years old.

Diagnosis.—The diagnosis is made out from the history of the case, the changes in the foot, and the nature of the lameness. When in doubt, the injection of cocaine over the digital or plantar nerves will decide whether the seat of lameness is in the foot or higher up.

Prognosis.—The prognosis is bad, because once the disease is established it is incurable, and the best that can be hoped for is that the horse will prove useful for a reasonable time after the performance of neurectomy. A comparatively favourable but rare termination of the malady is adhesion between the navicular bone and the perforans tendon as the result of plastic synovitis, as it arrests the friction between the two structures and thereby prevents the pain and laceration of the tendon caused in this way, and enables the horse to go sound if the inflammation is not too severe in the bone. In bad cases rupture of the tendon may supervene after repeated laceration by friction against the rough bone.

Treatment.—On account of the incurable nature of the disease treatment is unsatisfactory. Veterinary surgeons of the old school claimed to have treated it successfully by bleeding from the jugular, by purgation, by applying poultices to the feet, and by giving prolonged rest or by turning the horse out on marshy pasture; also by the insertion of a frog seton passing through the plantar cushion from the hollow of the heel to the point of the frog just behind the plantar aponeurosis and left in position for about three weeks, and cleaned daily, its object being to favour union between the navicular bone and the perforans tendon.

Grooving the contracted hoofs and applying light shoes are other procedures said to have good effect. The former usually has a palliative result by relieving the pressure on the inflamed region, but the light shoes can only be beneficial in favouring frog pressure and acting as a preventive rather than as a curative agent. Many of the so-called cures were cases of temporary improvement or mistaken diagnosis, for it is now universally admitted that in a true case of the disease cure is out of the question. In order to render the animal workable, it is necessary to remove or diminish sensation in the foot by performing neurectomy on the digital or plantar nerves or on the median nerve. Digital neurectomy is usually sufficient, but sometimes, at a variable period afterwards, lameness recurs, due to the inflammation spreading above the seat of the operation, when it is necessary to do either double plantar or median neurectomy. The latter frequently has the desired effect and is then preferable to the former, inasmuch as it does not entirely deprive the foot of its innervation, some being still supplied by the ulnar nerve through the external plantar, which is formed by the union of the ulnar with a branch from the median, the internal plantar being formed entirely by the latter. The objection to completely unnerving the foot is that it may in consequence undergo degeneration and lose its vitality, with the result that the hoof is shed or that the perforans tendon ruptures, necessitating the destruction of the horse. Fracture of the navicular bone is a fairly common sequel to the operation, being favoured by the brittleness caused by rarefying ostitis, and actually produced by the foot being brought more forcibly to the ground on account of the absence of sensation therein. An open wound of the tissues below the seat of operation greatly favours their degeneration by allowing the entrance of infection. A wound may be inflicted in the foot, and escape notice owing to the patient not feeling any pain for want of nerve supply.

(For "Neurectomy," see pp. 999-1003.)

Sand-crack.—Sand-crack is a fissure in the wall of the hoof, extending from the coronet downwards to the horn fibres, involving only a part or the whole of the height of the wall. It may appear at any part of the hoof, but is most commonly situated at the toe of the hind foot and at the quarter of the fore foot. The crack may be complete or incomplete, superficial or deep, recent or old, and simple or complicated.

Predisposing causes are alternate moisture and dryness of the horn, rendering it brittle; anything which weakens the horn, such as excessive rasping of the wall, or injury to the coronary band causing it to secrete inferior horn; and heredity.

Symptoms.—The chief local symptom is the presence of the crack, which varies in character. It may be a simple fissure, or complicated with injury and inflammation of the sensitive laminæ, causing a discharge from the crack of blood or serum or pus, when infection has gained entrance. Injury to the sensitive tissues is caused by tearing of the laminæ or by their getting pinched between the lips of the crack. In cases of decided inflammation there is a painful swelling on the coronet in the vicinity of the split in the wall.

If there be necrosis of the exposed tissues, or caries of the pedal bone, a large inflammatory swelling forms, extending over the digital region. Lameness only occurs when there is inflammation of the sub-corneal tissues, or when they are pinched in the crack during progression.

When lameness accompanies a sand-crack at the toe, the horse lifts the leg, usually a hind one, spasmodically, as in stringhalt, holds it suspended for a while, and then carries it well forward and puts it cautiously on the ground, heel first. This peculiarity of gait is more noticeable in the hind than in the fore limb.

Prognosis of a simple crack is good, as it usually responds readily to treatment. Complicated cases vary in gravity according to the nature of the complication. Non-purulent or slightly purulent inflammation is comparatively easily dealt with, but complications such as extensive suppuration beneath the horn, gangrene of the soft tissues, necrosis of the extensor pedis tendon or of the lateral cartilage, and purulent ostitis are troublesome lesions, while septic arthritis when it supervenes is an incurable condition.

Diagnosis is usually easy when the foot is carefully examined. If the hoof is covered with mud the sand-crack may be hidden, or it may be skilfully concealed by filling it with wax or gutta-percha. In a doubtful case, scraping the suspected region with a hoof knife will decide the matter. A crack beginning at the plantar aspect of the wall and only extending through a part of its height is not a true sand-crack, being simply due to the lower border of the wall being split as the result of becoming overgrown or not being protected by a shoe.

Sand-crack at the Toe.—Sand-crack at the toe of the foot is most common in the hind limb of the cart horse, and is apparently due to the pressure caused on the coronary border of the hoof by the os corona when the horse is bearing on the toe during heavy draught. It may be due to slipping from one pavement block on to another when pulling a heavy load on a paved street. It is certainly most frequently met with in heavy horses working in cities.

Treatment. — I. **Simple Sand-crack without Lameness.**—The treatment comprises: 1. Immobilization of the lips of the crack. 2. Stimulation of the coronary band to secrete new horn to fill up the crack.

1. *Immobilization of the lips of the crack* may be effected by (*a*) a special shoe; (*b*) a bandage; (*c*) the use of sutures made by horseshoe nails or clasps; (*d*) plugging the fissure with a piece of wood or gutta-percha; (*e*) by making grooves across the fissure; (*f*) by thinning the borders of the crack.

(*a*) *Special Shoe.*—A special shoe, divided in the inner half of its width at the toe, and provided with clips at the inner aspect of the heels, which fit into the lateral lacunæ, has been employed. After the shoe has been nailed on, an instrument is applied between the branches of the shoe at the heels by means of which the latter are dilated, with the result that the hoof is also expanded posteriorly and the edges of the crack are brought into and kept in closer apposition. This method of procedure has often given good results.

(*b*) *A Bandage.*—This is usually in the form of a tar rope coiled round the hoof. It can have little effect in preventing movement of the edges of the crack, and probably its chief use is in keeping dirt out of the fissure and diminishing the risk of infection and inflammation. A strong rubber band round the hoof has been used effectively by Mr. Charles Allen, F.R.C.V.S., of Dublin.

(*c*) *Sutures.*—Driving a horseshoe nail across the crack, cutting off its ends and clenching it towards the fissure, is very effective. It requires considerable skill to insert the nail sufficiently deeply to get a good grip without injuring the sensitive tissues. A little transverse groove is first made on either side of the slit to receive the nail, which is then driven through with a hammer. To facilitate its introduction, a hole may be made with a drill to accommodate the nail. The hot iron used in connection with the clasps may be employed here to make the groove for the nail. One nail may be sufficient, but it is usual to insert two, the upper one being about half an inch below the coronary band and the other about the centre of the wall. Wire clasps, inserted by a special forceps in much the same manner as a pig ring is introduced, are not so serviceable as the nails, not having so deep a hold, and sometimes becoming loose and falling out. A depression is first made with a special hot iron to receive the clasp, which is easily and rapidly introduced by means of the forceps, into whose jaws it fits exactly.

(*d*) *Inserting a Piece of Wood into the Crack.*—A piece of wood driven into the fissure from its plantar aspect prevents pinching of the sensitive laminæ and excludes dirt therefrom. The horn on either side of the crack must be pared to make room for the piece of board, which should be made to fit into a slot on either side like the lid of a crayon box.

(*e*) *Making a groove across the crack* in its upper third intercepting the transmission of pressure along its borders towards the coronet diminishes their pinching effects superiorly. Two or three such grooves are more effective, having the desired result lower as well as above.

This procedure, however, cannot be very effectual in preventing movement of the borders of the fissure.

(*f*) *Thinning of the Lips of the Crack.*—Paring the borders of the slit to relieve the pressure of the horn on the sensitive tissues may be done. Making a groove on either side of the crack at about half an inch from it on its upper part converging to meet it at its lower end, thus mapping out a V-shaped area, and thinning the horn within it, is another way of producing the same effect.

In all cases it is advisable to relieve the bearing on the shoe in the vicinity of the affected part by lowering the wall here or by truncating the shoe on its corresponding foot surface.

2. *Stimulation of the Coronary Band.*—This is effected by blistering or firing the coronet. When the hot iron is used three transverse lines may be made, viz. one across the crack at its lower third, one at its upper third, and one on the coronet, or one may be made about half an inch below the coronary band, one on it, and one about half an inch above it. Those on the wall go almost right through the horn, and simply have the effect of preventing the transmission of pressure along the edges of the crack.

II. **When Lameness is Present.**—In this case measures are taken to allay the inflammation in the sensitive tissues by removing the shoe and treating the foot with warm antiseptic baths, as the result of which the lameness may disappear when the case is treated as already described. If the lameness persist after this procedure has had a fair trial it will be necessary to relieve the pressure on the inflamed part by thinning the borders of the fissure, or better, by thinning a V-shaped area as explained above. If this be insufficient and a purulent discharge continue to ooze from the cleft, there is evidence of the presence of infected tissue in the inflamed region, and it must be removed by an operation, which consists either in thinning the horn at its level, or stripping it off here by making a groove right through the wall on either side of the fissure and another at the white line, and tearing off the isolated piece of horn by means of a pincers, and then excising the necrotic laminal tissue with a knife and scraping the os pedis with a curette if it be affected with superficial necrosis.

The wound is dressed with an antiseptic pad and bandage covered by a strong leather boot, or by an improvised boot made from plaited straw. The dressing is removed after two or three days and then reapplied. The horn growing from the coronary band must be redressed occasionally until the wound is completely healed. When the breach in the wall is covered by provisional horn formed by the laminæ, it should be covered with tar and tow kept in position with a strap buckled round the hoof, or it may be filled with gutta-percha.

Sand-crack at the Quarter.—Sand-crack at the quarter is most common on the inner aspect of the fore foot and in horses doing fast work. Contracted feet are most likely to be affected. Feet with low heels are also subject to it. When there is deformity of the feet, such as turned-in or turned-out toes, it is the surcharged quarter which is likely to become fissured.

Treatment.—The treatment is on the same general principles as that of sand-crack at the toe, but nails or clasps driven across the crack are not suitable, as the horn is hardly thick enough to bear them as a rule. The most common procedure here is the formation of a groove crossing the crack at its upper part intercepting the transmission of pressure from the ground towards the coronet. If lameness supervene the foot should be treated for inflammation as before.

Sand-crack in one of the Bars.—Treatment here is to thin the horn in its vicinity and protect the part with a wide-webbed shoe and a leather or metal sole, keeping a dressing of tow and tar in contact with the part.

Transverse cracks may be superficial or deep. They result from injury to the coronet and separation of the horn in this region. As the horn grows down the separation becomes a fissure. If they go right through the wall they cause lameness by crushing or tearing, the podophyllous tissue between their lips allowing the entrance of infection.

Seedy-Toe.—"Seedy-toe" is an affection of the foot characterized by separation of the wall from the sub-corneal horn and the formation in the interspace of crumbly pumice-stone-like horn secreted by the sensitive laminæ. This abnormal horn does not completely fill the space beneath the wall, which is consequently more or less hollow.

Etiology.—The cause is generally obscure, but the condition would appear to be the result of a local chronic laminitis following traumatic injury such as might be caused by a too closely driven nail, or by the compression of a large clip. Wide-spreading feet are most subject to it.

Symptoms.—The lesion may be present for a good while before being detected, and is usually first recognized by the farrier when preparing the hoof for shoeing. The foot appears quite normal when resting on the ground, but if the wall be struck on its outer aspect with a hammer a hollow sound will be emitted opposite the affected part. The extent of the affection varies in depth and peripheral area. It may occupy any region of the circumference of the wall, and may affect only the lower portion of the latter, or extend even as far as the coronet. Lameness is absent when the area affected is small, but when there is considerable separation of the horn the sensitive laminæ are insufficiently protected from concussion, and foreign matter accumulates in the space, causing pressure on the laminal surface, the result being more or less well-marked lameness. The abnormal horn is easily broken down with the knife.

Prognosis depends on the depth and area of the lesion. When circumscribed it is not of much consequence, not causing lameness and allowing the horse to work during treatment. When a large part of the foot is involved to a great depth beneath the wall, causing lameness, months may elapse before the horse is fit to work.

Treatment.—Pare away the new formation of horn to diminish the pressure on the sensitive structures, pack the cavity with tar and tow, and apply a shoe, having no bearing on the affected region, and a leather sole to keep the dressing in position.

If the disease extend far up beneath the wall it will be necessary to remove a portion of the latter at the level of the lesion in order to expose it and enable the abnormal horn to be pared away.

A bar shoe with a breach in the iron opposite the affected part is suitable. Apply a blister to the coronet to promote the growth of normal horn.

Keratoma is a horn tumour growing from the inner aspect of the wall of the hoof. It varies considerably in volume, form, and extent. Its diameter measures from about a quarter of an inch to half an inch. Its shape may be cylindrical, conical, pyramidal, or irregular, and it may be bifurcated at its upper extremity. It may extend up only a portion of the wall or its full height, or even bulge into the cutigeral groove. Exceptionally it is only adherent at its lower part. It may be solid or fistulous, the fistula terminating in the tumour or passing through it to abut on the laminæ and having its lower orifice at the white line.

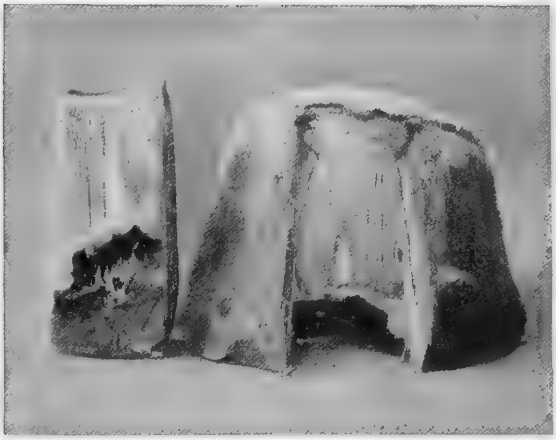

FIG. 158.—Horn tumour.

Etiology.—The condition is due to hyperactivity of the laminæ or coronary band, caused by some injury or irritant, whereby an abnormal quantity of horn is secreted. In this way it may result from mechanical injury of the wall or coronet, or from a closely driven nail compressing or penetrating the laminæ, or from dirt gaining entrance through a sand-crack or a separation between the wall and the sole. There is another and comparatively rare form of keratoma which appears independently of inflammation or irritation of the horn-secreting structures. It may be adherent or free, and of similar dimensions to the one just described.

Symptoms.—The tumour may develop insidiously, and be present for a considerable time before being detected. Its presence is recognized on examination of the plantar aspect of the foot by the abnormal appearance of the horn at the place corresponding to the lower end of the growth, between the wall and the sole, the white line being deviated inwards here. If fistulous, a probe can be passed into it, and the fistula may be discharging pus. The pressure of the tumour on the laminæ and the os pedis may cause inflammation and lameness.

The former is indicated locally by pain on percussion at the level of the lesion, and by abnormal heat on palpation.

The latter varies in degree. The abnormality in gait may be of the nature of stringhalt. The wall may bulge over the tumour. When the sensitive tissues become infected through the fistula the affected laminæ may undergo necrosis and the os pedis may become affected with caries. The pressure of the new horn causes atrophy of the laminæ, which eventually disappear, preventing further increase in size of the tumour. The pedal bone may also undergo atrophy and become weakened in consequence, so that it may fracture under the body weight.

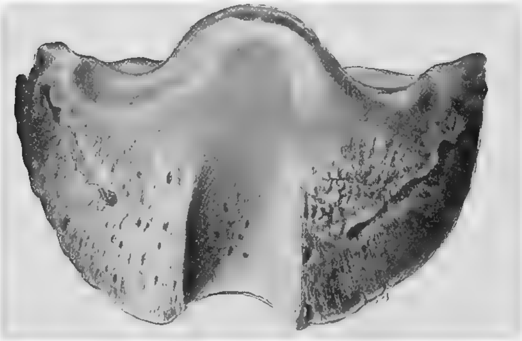

FIG. 159.—Os pedis showing effect of keratoma.

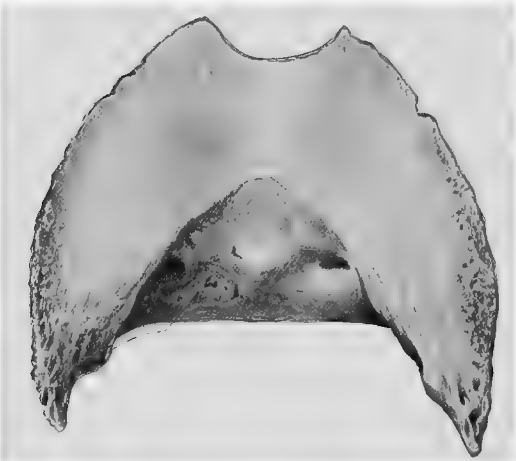

FIG. 160.—Os pedis—inferior surface—showing effect of keratoma.

Diagnosis of the condition is easy, owing to the characteristic appearance of the horn at the lower end of the tumour or to the presence of the fistulous orifice, into which a probe can be passed to abut on the tumour or pass through it as mentioned.

Prognosis.—The prognosis, generally speaking, is unfavourable, there being no tendency to spontaneous cure, and no means of effecting the latter except by operation, after which the tumour may recur.

Treatment.—If there be neither pain nor lameness it is sufficient to regulate the shoeing so as to have a minimum amount of bearing on the affected region.

When lameness supervenes palliative or curative measures may be adopted.

Palliative treatment comprises rest and antiphlogistic applications, which may cause temporary improvement, and, if these fail, paring out the tumour from below with a searcher, or boring it with a drill to allow it to collapse on itself and thus diminish the pressure on and consequent pain in the sensitive tissues until the tumour increases in size, when this procedure will require repetition.

Curative treatment consists in extirpating the portion of the wall on which the tumour is growing as follows: Make a groove right through the wall from the coronet to the plantar aspect on either side of the affected part, and another groove joining these at the white line. Seize the isolated portion of wall at its lower extremity with a pincers and forcibly strip it off. Protect the breach in the wall with an antiseptic dressing until it becomes covered with new horn. Then apply a dressing of tar and tow, kept in position by a bandage or a leather and strap round the hoof, the horse, if sound, being allowed to go to work wearing a shoe with the pressure relieved in the vicinity of the affected region.

Should the sensitive laminæ in the affected part be found necrotic or much altered by pressure or suppuration, they should be excised, and if the terminal phalanx is affected with caries the diseased surface should be curetted.

Separation of the wall from the sub-corneal tissue may occur apart from a horn tumour; for example, in wide-spreading feet of horses working on streets without lameness, or following the operation for quittor, or after contusion of the wall. When contusion affects the subcoronary region only, the separation is confined to this situation, and the condition is only suspected by the hollow sound emitted when the wall here is struck by a hammer. The treatment is to clean out any foreign matter that has accumulated in the space, and then fill the latter with pitch or tar and tow. If this proves insufficient in a case of lameness, it will be necessary to thin the separated horn to relieve pressure on the underlying parts, and if the laminæ are exposed and inflamed the use of a disinfectant is indicated.

A horn tumour sometimes forms on the deep face of the sole in flat or convex feet, in which it may arise from circumscribed chronic inflammation resulting from contusion. It is hemispherical in shape, its base being flush with the sole. The velvety tissue becomes atrophied through its pressure, and the os pedis may become excavated from the same cause. It is diagnosed by pain confined to the region affected, and elicited by percussion with a hammer, and by the dry, hard consistence of the horn of the tumour, which retains these characters after considerable paring, whilst that of its periphery, when cut to the same extent, causes bleeding by wounding the sensitive part. Infection of the lesion is rare.

Treatment.—Thin or hollow out the tumour to diminish its compressive effects, or remove it radically and excise necrotic tissue if present. Cover the wound until healed with an antiseptic dressing and a metal or leather sole fixed under the shoe.

Gathered Nail.—Punctured wound of the plantar aspect of the foot.

Etiology.—Punctured wound of the plantar aspect of the foot is caused by the horse treading on a sharp-pointed, hard resisting body, which penetrates the horn and enters the sensitive tissues to a varying depth. The wounding body may be a nail, a sharp piece of iron, the clip of a shoe, a stub of wood, a ladies' hat pin, a piece of shrapnel or portion of a shell.

The point of entrance may be in the sole or frog. When the sole is hard, concave, and free from cracks the offending object may glide from it into the lateral lacuna and enter the foot there. In the frog the commonest seat of puncture is near its point. The bar is seldom penetrated, owing to its obliquity and hardness.

The thinner and softer the horn the greater the risk of sharp bodies passing through it into the sensitive tissues.

The direction of the wound depends on the angle at which the foot meets the projecting point, and on the deviation which the latter may undergo by the weight exerted upon it. The lesion is one of the commonest affections of the foot, and is particularly frequent in horses working in places where objects of the nature mentioned are strewn. In military horses on active service it is the chief source of foot trouble.

Symptoms.—When the foreign body enters the horn it may not at once penetrate the sensitive tissues. This may occur from repeated force applied to it by the foot striking the ground during progression. Attention is generally first attracted by lameness, and when the foot is examined the cause of the trouble is usually discovered at once by finding the foreign body more or less firmly embedded in its plantar region. It may require a pincers to remove it from the foot. The object may, however, be broken on a level with the horn, when its situation may be recognized by a dark or abnormal spot corresponding to its distal extremity, or it may have become divided at some distance in from the surface of the horn and require to be searched for with the hoof knife before being discovered. When it is removed the lameness may disappear, and the resulting perforation in the horn may be so small that it is hardly visible. There may be some blood on the object when withdrawn, or a little hæmorrhage may appear at the orifice after its removal. When the wound is slight it may heal at once without further symptoms. If not, and the condition has existed for some days, infection will have supervened, and there will be a purulent discharge from the wound, blackish or whitish in colour or mixed with blood. The deep layers of the horn in the affected part will be infiltrated with moisture, yellowish, separated from the sensitive tissues. There is severe local inflammation, causing great pain and lameness. At a later stage the tissues will be more altered, owing to the prolonged action of the organisms causing more or less necrosis of the velvety sole or plantar cushion, and the purulent discharge will be more copious, a sinus being present. When important deep-seated structures are involved in the necrotic or septic lesion special symptoms are manifested according to the nature of the complication. If the os pedis undergo necrosis there will be a profuse escape of bloody pus, and a probe passed into the sinus will come in contact with the bone. The plantar aponeurosis may become necrotic, causing a constant purulent discharge until the affected portion is removed. Should the synovial sheath be opened there will be a purulent synovial discharge, and an inflammatory swelling will form in the hollow of the heel at the level of the sheath. The navicular bone may be ulcerated on its tendinous aspect or completely fractured. The interosseous ligament may be destroyed, allowing infection into the joint, setting up arthritis, which becomes manifested by a prominent coronary swelling with perhaps abscesses, which on bursting discharge offensive purulent synovia, and persist as fistulæ until the horse dies from septicæmia or toxæmia, or is destroyed, the case being hopeless.

Lameness is always well marked in connection with these deep-seated complications, which may prevent any weight being borne by the affected limb.

Diagnosis is easy after removing the shoe and paring the foot.

Prognosis.—The prognosis depends on the part affected and on the nature of the injury inflicted. Taking the plantar region of the foot as being composed of an anterior, middle, and posterior region, the most serious part to be perforated in a more or less upright manner is the middle region, because most of the important structures of the foot are situated directly above it. After it comes the anterior regions, in which the os pedis may be injured. The posterior region is made up practically entirely of the plantar cushion, lesions of which are comparatively benign, being always followed by recovery when rationally treated. When the case is seen early, before complications have arisen, the latter may be prevented by careful treatment. All the septic lesions of the foot arising in the manner described respond to treatment except arthritis, extensive disease of the os pedis, and fracture of the navicular bone.

The degree of lameness present and the horse's temperature serve as guides as to the gravity of the condition. The lameness, however, may be extremely severe, no weight being borne by the affected limb, and yet the case may be amenable to treatment; for example, septic synovitis of the small sesamodean sheath causes alarming symptoms, but when it is properly treated recovery ensues. When arthritis supervenes, or when the navicular bone is fractured, the case is hopeless, but ulceration of the cartilaginous surface of the tendinous aspect of the bone may be successfully treated by curetting the affected spots and using antiseptic applications.

Treatment.—An injection of anti-tetanic serum is indicated to prevent tetanus. The treatment in a recent case before suppuration has had time to ensue is that of an ordinary open wound. It consists in removing the offending body and any other foreign matter that may have gained entrance, providing drainage, and applying antiseptic solutions to prevent the development of micro-organisms and the complications to which they give rise. These indications are carried out as follows: Having extracted the wounding body, thin the horn round the orifice of the wound over an area of the diameter of a half to a crown piece, to facilitate the escape of discharge should it form, to relieve pressure on the injured region, and to allow the antiseptic lotion to come into contact with the wound.

It is a good and common practice to pour into the wound immediately a little pure carbolic acid or pure creolin, which ensures the destruction of any bacteria that are present, and causes no ill effects from the superficial destruction of sensitive tissue to which it gives rise. Afterwards protect the wound with an antiseptic dressing of iodoform and cotton-wool or a moist antiseptic compress, kept in position by a bandage and boot, or by strips of hoop-iron or a metal plate inserted between the shoe and the hoof. An excellent treatment is to immerse the foot, after thoroughly cleaning it, in a warm antiseptic bath made with any reliable antiseptic agent for at least half an hour two or three times daily, there being perhaps nothing better than perchloride of mercury (1–1000), the wound in the intervals being dressed as described. When inflammatory symptoms fail to appear and the horse goes sound it is evident that the treatment has had the desired effect in preventing septic infection, and the animal may be allowed to work with the protective dressing applied. Should the wound be fairly large and the sensitive tissues exposed, excessive granulations are likely to form from the irritation caused by the edge of the surrounding horn, and it will be necessary to remove them with the knife if large, or, if smaller, by the application of a caustic, such as powdered sulphate of zinc or perchloride of mercury or sulphate of copper. When the exposed wound is cicatrized and covered by horn, put on a dressing of tar and tow covered with a metal or leather sole.

In slight cases where the wound is superficial one or two applications of an antiseptic dressing are generally sufficient.

When the lesion is of some standing and discharging pus, it must be treated as a sinus by adopting measures to provide for the drainage of the purulent material, to remove necrotic tissue, and destroy the organisms which have invaded the affected part. Paring the horn round the seat of injury, and removing it entirely where it is under-run, followed by the use of the antiseptic foot bath once or twice daily and an antiseptic dressing in the meantime, often proves effective in the course of a few days. Should this procedure fail it may be concluded that there is necrotic tissue in the wound requiring removal. This may be effected by the use of a caustic, or the hot iron, or by surgical interference. The operation consists in opening the sinus to its depth and curetting its interior, so as to remove all unhealthy tissue and leave a clean open wound which will granulate and heal in the ordinary way, when carefully protected from infection, until it is uniformly covered by granulations. It may involve incision of the plantar aponeurosis where it is inserted into the plantar aspect of the os pedis, scraping of the latter when affected with necrosis, or curetting the ulcerated surface of the navicular bone. It is necessary to remove the greater part of the plantar cushion to enable these deep-seated parts to be operated upon.

To resect the plantar aponeurosis, first expose it by excising the greater portion of the plantar cushion, excavating a cone-shaped wound whose depth represents the apex of the cone, and then cut it transversely at the level of the navicular bone and remove its distal portion from its insertion into the third phalanx. Irrigate the cavity with an antiseptic solution, paint it with tincture of iodine, powder it with iodoform, pack it with sterilized gauze, and cover it with a pad of sterilized cotton-wool and tow.

Envelop the foot in canvas and enclose it in a boot, or keep the dressing in position by strips of iron or a sole, as mentioned before. It is advisable to put the horse in slings, as he is unable to stand on the affected limb for some time. To ensure keeping the wound sterile immerse the foot daily for a while in an antiseptic bath and renew the dressing. When granulating throughout, occasionally dressing the wound without using a lotion will be sufficient. The result of the operation when carefully performed and followed by strict attention to the wound is usually successful, the latter gradually granulating and closing in to become completely healed in about six weeks. After about a fortnight the patient commences to put weight on the limb, and thence onwards improves by degrees until he goes almost, if not completely, sound in the course of six or eight weeks. Sometimes an abscess forms in the hollow of the heel, but is not of serious consequence, healing as a rule on bursting or being opened and drained. A seton passed vertically through the cavity acts as a drainage-tube. Rarely the proximal end of the perforans tendon undergoes necrosis, requiring renewed intervention to remove the affected part and protracting the duration of recovery. In exceptional cases, lameness persists after healing of the sinus, due sometimes to hyperæsthesia in the cicatrix and at other times to contraction of the hoof following the prolonged inactivity of the foot and the removal of the frog and greater part of the plantar cushion.

To avoid removal of the frog and consequent contraction of the heels after the operation, it has been suggested to incise the plantar cushion antero-posteriorly, reflect each half laterally to enable the aponeurosis to be reached, and afterwards unite the two parts of the cushion by wire sutures. It does not seem to be a very practicable procedure.

Corns.—A corn is a contusion of the sensitive tissues at the heel in the angle between the wall and the bar, the structure affected being the sensitive tissue of the sole, wall, or bar. The condition is most common in horses working in cities.

In an ordinary recent or dry corn there is merely an escape of blood from the injured vessels, causing more or less staining or ecchymosis of the overlying horn in a punctiform, linear, or diffuse manner. If the cause be repeated, the condition becomes aggravated and the inflammation becomes more severe, but remains aseptic so long as there is no breach in the horn to allow the entrance of infection. When the contusion is severe the horn in the affected part becomes infiltrated with serum, or the latter may accumulate beneath the horn, giving rise in either case to a *moist corn*. When infection ensues through an accidental fissure in the horn, or as the result of excessive paring of it, the lesion suppurates and a *suppurating* or *festered* corn is produced.

The corn is said to be *complicated* when it is accompanied by necrosis of any of the tissues in its vicinity, such as the laminæ, the plantar aponeurosis, the lateral cartilage, or the plantar cushion.

Etiology.—Corns are very rare in unshod feet. Consequently shoeing is blamed as the primary cause of the affection.

Any defect in shoeing which results in excessive pressure or weight being brought to bear on the seat of corn favours the condition. Fitting the shoe very close on the inside to avoid the risk of brushing may have this effect, and the frequency with which this is done probably accounts for corns being more common in the inner heel. Faulty conformation of the limbs causing unequal distribution of weight on the foot is a predisposing cause, and it is for this reason that corn more often affects the outer heel when the toe is turned in.

Interference with the anti-concussion mechanism such as is caused by atrophy of the frog, high-heeled shoes preventing the frog reaching the ground, high contracted heels preventing expansion of the posterior region of the foot, upright pasterns causing increased concussion on the bony column of the limb, favours the production of the lesion. Fast work on hard roads, especially in the case of heavy horses, is a fruitful source of contusion of the heels if the shoeing is not carefully attended to. That concussion is a prime factor in producing corns is proved by the fact that they are very rare in the hind feet while they are very common in the fore feet, where concussion is greater.

Wide spreading feet with low weak heels are likely to become affected owing to the horn affording insufficient protection to the sensitive tissues of the region where the greatest shock is received by the foot. Leaving the shoes on too long causes them to be drawn forwards by the growing wall, and may thus result in their heels being brought to bear on the seat of corn and to give rise to the affection.

A stone accidentally fixed between the heel of the shoe and the frog may cause a bruise in this situation.

Symptoms.—A corn during the acute stage is characterized by local symptoms of a contusion with more or less acute inflammation and by a varying degree of lameness. The local phenomena are in accordance with the nature of the lesion. Pain is evinced on percussion and compression of the affected heel. Abnormal heat is revealed on palpation. In the case of a dry corn, paring the horn in the affected region discloses the staining of its deeper layers varying from a glossy yellowish appearance to a deep red tinge, occupying an area of varying dimensions in different cases.

In a moist corn the overlying horn is infiltrated with serum, which makes it moist in its deeper parts, or the liquid may accumulate beneath it and escape when an exit is made with the knife. When suppuration supervenes the inflammatory symptoms are very intense, and, if the pus is not allowed to escape by removing the horn which confines it, it will extend upwards to the coronet and become discharged there through the medium of an abscess.

The pain is very acute until the pus gets an outlet, when it is greatly relieved.

When a sinus persists it is due to necrosis of some of the tissues in the region caused by septic organisms, and a probe passed into it will give an idea of the depth of the lesion and the part affected.

Quittor is a common sequel to suppurating corn and is very likely to ensue after the pus has reached the coronet, and when it does supervene in this case the orifice of the first abscess between hair and hoof does not constitute the opening of the quittor, which forms at a higher level by the bursting of a secondary abscess after the primary one has healed. The sinus may also appear on the plantar aponeurosis or the os pedis. The lameness varies in its degree according to the nature of the local lesion. In a well-marked case the horse goes on his toe with the heels clear of the ground and, when standing, "points" the affected foot, that is, holds it in front of the other one, resting only on the toe. When both feet are involved the animal has a short pottering gait and at rest points the two feet alternately. In "suppurating corn" the lameness is extreme until vent is given to the pus.

In an old-standing case of corn in which the pain and lameness have disappeared, the only indication of the lesion will be the discoloration revealed on paring the corn.

Diagnosis.—The diagnosis is easy and is made out from the symptoms. The changes in the horn are characteristic.

Prognosis.—The prognosis depends on the character of the lesion. If it be simple contusion it is of little or no consequence, lameness being slight or perhaps absent; when more marked it is more serious, causing greater lameness, which may persist for a considerable time. Purulent corn is serious on account of the troublesome complications to which it may give rise.

Treatment.—Treatment consists in removing the cause and adopting the usual methods for dealing with inflammation or an abscess or a sinus, as the case may be.

Removal of an offending shoe may be all that is necessary. Paring the horn over the corn has a decidedly good effect in relieving tension on the affected part, but care must be exercised not to overdo it by wounding the sensitive tissues and causing a risk of infection.

When suppuration supervenes a free exit must be made for the pus by removing the underrun horn, and the foot should be immersed in an antiseptic bath for a half-hour to one hour morning and evening until the discharge ceases, the lesion being protected in the meantime by an antiseptic compress or a dry dressing. The wound in the sensitive tissues usually granulates excessively owing to the irritation caused by the edges of the cut horn. The exuberant granulations must be removed with a knife or caustic, the wound being afterwards treated with an astringent or slight caustic to prevent recurrence. When suppuration has extended upwards beneath the wall it is advisable to remove a Λ-portion of the latter to ensure the escape of the pus. Complications must be treated according to their nature, the principles of treatment being those of a sinus.

When the wound following a suppurating corn is healed and covered with horn, and in all cases where the horse is going sound, a shoe having no bearing on the affected region, and a leather sole with a dressing of tar and tow, should be applied. An ordinary shoe, with the wall shortened so as not to bear on it at the affected heel, or a shoe truncated or excavated on its foot surface, or a bar shoe with the bar resting on the frog or a three-quarter bar shoe, the iron being omitted opposite the seat of corn, may be used.

Pricks in Shoeing.—A prick or wound, caused by driving a nail into the sensitive tissues in the act of nailing on a shoe, is of two kinds, viz. (1) where the offending nail is withdrawn immediately after being driven, and (2) where it is not withdrawn. Another variety of the lesion similar to the second is one caused by an old stump, remaining in the wall since the previous shoeing, being driven into the sub-corneal tissues by the force of the newly-driven nail which comes in contact with it.

Etiology.—The accident is favoured by several circumstances such as: 1. *Contraction of the hoof*, rendering the wall less oblique and thereby making the nail more likely to take an inward course. 2. *Thinness of the horn*, which accounts for pricking being more common in the inner than in the outer quarter of the foot. 3. Want of skill on the part of the doorman in failing to drive the nail properly. 4. *Faulty workmanship* in making the shoe, stamping the holes too coarse or too oblique, causing the nails when driven to be diverted towards the sensitive laminæ. 6. *Badly-shaped nails*, the malformation making the nails take a wrong direction. 7. *Restiveness* of the horse, resulting in the animal violently snatching his foot from the shoer when a nail is only partly driven and stamping the foot with great force on the ground and forcing the nail into the flesh.

The lesion is more common in hind than in fore feet, due probably to the fact that the horn is more upright behind than in front and that the hind foot is often more difficult to control than the fore foot.

During the busy time when horses are being roughed for frost, the hurried way in which shoes are put on after being removed may lead to pricking.

The amount of damage done by the nail will, of course, vary according to the depth of the injury and the part affected. The nail may merely touch the sensitive laminæ, or it may wound or even fracture the pedal bone.

Symptoms.—During the process of shoeing it may be recognized that the nail is being wrongly driven by (*a*) the sound of the hammering which, instead of becoming clearer, becomes duller, due to the nail entering the soft tissues; (*b*) the nail meeting with less resistance as it penetrates deeply, showing that it is not taking an outward course towards the hard surface of the wall; (*c*) resentment of the horse, which snatches away the limb suddenly; (*d*) blood appearing on the nail when it is withdrawn or oozing from the orifice in the horn.

The blood, however, may be wiped off the nail in its passage through the horn and the hole in the latter may close by its walls falling into contact, thus preventing the escape of blood. The flinching of the horse may be prevented by the use of a twitch, or ascribed to temperament when the animal is of a fidgety disposition, or it may not be noticed.

A simple prick where the nail is immediately withdrawn and the nail-hole left vacant is usually of no consequence, but when the nail is left more or less embedded in the soft tissues lameness supervenes immediately or may be delayed for a day or perhaps for several days.

The diagnosis of the cause of the lameness is easy. The horse having been recently shod, irregularity of the clenches, one or more being unusually high, perhaps the absence of a nail, arouse suspicion, which is confirmed by examination of the foot revealing symptoms of inflammation at the seat of injury. Pain is evinced on percussion, and abnormal heat is felt on palpation here. Cutting the clench of the offending nail and traction on the corresponding branch of the shoe in removing it are resented by the patient. When the nail which caused the injury is withdrawn it is seen to be black, from the action of the sulphur of the horn on the nail. A greyish, whitish, or blackish discharge escapes from the hole in the horn. When the nail-bed is pared out it is found to be surrounded by soft blackish horn infiltrated with the purulent discharge and more or less separated from the sub-corneal tissue.

Prognosis.—A simple slight prick of the sensitive tissues, in which the nail is at once extracted and omitted, is usually of no consequence, neither pain nor lameness supervening. The other form of prick caused by the nail being left inserted in the sensitive laminæ may have serious consequences, such as diffuse inflammation of the foot, or necrosis of the horn-secreting structures, the os pedis, or the lateral cartilage.

Treatment.—When the prick has been discovered during the shoeing, it is usually sufficient to leave the corresponding nail-hole vacant, but to prevent the possibility of infection a little antiseptic solution may be poured into the orifice, or the latter may be closed by collodion, or a red-hot nail may be passed rapidly into the hole in the horn and quickly withdrawn, to act as a germicide. This is a common practice with farriers.

Should a severe wound be inflicted, the horn all round the track of the nail should be thinned to favour the exit of discharge in case any may form as the result of infection of the wound, which should be prevented as far as possible by antiseptic applications such as a little pure or strong solution of carbolic acid or creolin poured into the orifice, or the use of a foot-bath. No lameness may ensue; if it does, the treatment should be continued and the horse kept at rest until it disappears. In the case where inflammation and suppuration have taken place before the condition is detected, or as a sequel to infection in the first case, the shoe must be removed, the horn thinned in the vicinity of the affected region, and the foot immersed in an antiseptic bath for half an hour to an hour morning and evening until the discharge ceases and the lameness disappears, the part being protected in the intervals between the immersions by a moist or dry antiseptic pad kept in position by a boot or poultice-bag. When suppuration is extensive beneath the wall it is advisable to remove a portion of the latter to provide free drainage and relieve pressure on the inflamed area.

There is usually no difficulty with the case when treated on these lines provided that some of the complications mentioned have not arisen, when special measures may be required according to the nature of the case as described elsewhere.

When the horse is sound a dressing of tar and tow should be applied over the seat of the lesion and kept in place by a leather sole. The animal is then fit to go to work.

Contracted Hoof.—A contracted hoof is one whose wall has become contracted or shrunken in one or more situations, usually in the regions of the quarter and heels on one or both sides of the foot.

The condition is more common in the fore than in the hind feet.

Etiology. — Anything causing dryness or brittleness of the horn, or which prevents expansion of the hoof, favours its contraction, for example :

1. *Injudicious use of the rasp*, filing the outer surface of the wall and thereby removing the periople or varnish, which prevents evaporation, and consequent dryness and shrinking of the horn, and also removing some of the superficial fibres of the horn, thus exposing the deeper ones to the action of the air and allowing them to become dry and contracted.
2. *Chronic lameness*, diminishing the activity of the foot and consequently its expansion.
3. *Excessive paring of the frog*, causing it to become dry and contracted, and preventing its coming in contact with the ground to promote dilatation of the heel region of the foot.
4. *Mutilating the bars*, and in this way removing or weakening the buttresses or stays of the wall and permitting it to fall inwards at the heels.
5. *Shoeing with calkins* or thick-heeled shoes, absolutely preventing the frog bearing on the ground and acting as an expansile apparatus.

Want of frog pressure is probably the chief cause of the abnormality.

Navicular disease affords a good illustration of the symptomatic form of contraction, as it is a symptom of this malady and due apparently to the horse going on the toes and easing the heels.

Symptoms.—When the foot is on the ground and viewed from in front, the deformity is noticed, and when unilateral, the contrast between the two sides of the hoof is very striking. When looked at from the plantar aspect, the marked difference in length of the antero-posterior and transverse diameters of the hoof is observed, the former being decidedly in excess of the latter, whereas a normal fore foot is about as broad mesially as it is long. The narrowness is most noticeable in the posterior part of the quarter and at the heels. The normal length of the hoof is not altered. The bars are less divergent posteriorly than usual, having a tendency to approach each other behind. The frog is always more or less atrophied and the lateral lacunæ are abnormally deep.

Frequently the horn is dry and brittle.

Lameness may be present as the result of the contraction alone or of the disease which gave rise to it.

Prevention of the deformity consists in avoiding the causes mentioned, and, above all, in maintaining frog pressure as far as possible by shoeing with tips or thin-heeled shoes or by the Charlier system, by leaving the frog intact when preparing the hoof, and by the use of rubber pads bearing on the frog when the latter is not sufficiently developed to reach the ground with an ordinary shoe applied.

Treatment comprises : (1) Improvement of the method of shoeing ; (2) the use of dilating or expanding shoes ; (3) grooving the wall to permit of its expansion.

(1) Improvement in the method of shoeing may be sufficient in slight cases, such as substituting flat shoes for those with calkins, or adopting some of the measures mentioned under the heading of prevention.

(2) The use of mechanical means to cause expansion of a contracted hoof is not much in vogue, although several special shoes have been invented for this purpose, especially on the Continent. None of them is of sufficiently proved merit to deserve description.

A shoe whose bearing surface, instead of being horizontal, is made to slope downwards and outwards, is believed to have some effect in expanding the hoof.

(3) When the hoof is decidedly contracted, and especially if lameness is present, the best treatment is to groove the horn in the affected region as follows : At the anterior part of the contracted region make a vertical groove in the wall about $\frac{3}{16}$ of an inch wide, by means of a firing-iron and a searcher, going right through the horn without injuring the sensitive tissues. At the heel make a similar groove almost parallel to the horn fibres, downwards and forwards. Between these grooves make two others parallel to the posterior one. Join all these grooves by one made through the white line, that is, the commissure between the sole and the wall. Remove the lower ends of the isolated portion of horn with the rasp and knife to prevent their coming in contact with the shoe afterwards. Operate on one or both sides according as the condition is uni- or bi-lateral. Fill the grooves with tar. Put on a bar-shoe with a leather sole, the bar resting on the frog and the shoe having no bearing on the grooved portion of the wall. If the frog be too atrophied to reach the bar of the shoe interpose a rubber pad between them to bring pressure on the former. Have the horse exercised daily to promote frog pressure and expansion. If the hoof is very hard the foot may be poulticed for a few days to soften the horn and make it more elastic and dilatable.

In the course of about three weeks the good effect of the operation will be noticed, the hoof being decidedly wider in the region where it was contracted and the horse going much better, if not quite sound. Even if the condition is the result of navicular disease temporary improvement may ensue. If the patient does not eventually become completely sound, it may generally be concluded that the case is one of navicular disease, and must be treated accordingly.

Nail Binding.—The condition known as "nail binding" is that caused by driving a nail or nails too close to the sensitive laminæ without wounding them, but causing more or less pain or discomfort by pressure thereon.

It most commonly occurs in feet with a thin crust.

Symptoms.—The affection is manifested by cramped action or lameness, which is usually slight, and by symptoms of mild local inflammation, viz. pain on percussion or compression, and some abnormal heat on palpation of the affected part.

Treatment.—Removal of the shoe and the application of cold or hot compresses or swabs for two or three days have the desired effect. A prick is generally suspected, and, if care is not exercised in searching for it, the sensitive tissue may be wounded and infected, complicating the condition.

Bruised Sole.—Contusion of the sole may be caused by the foot treading heavily on a projecting or loose stone or by a badly-fitting shoe. The bearing surface of the hoof on the shoe should be confined to the wall, the white line, and that portion of the sole in contact with the wall.

Chronic Coronitis or Villitis.—Chronic dermatitis of the perioplic band and coronary cushion.

Etiology.—The etiology is often obscure. A form of the affection accompanies skin diseases in some cases or follows a febrile condition.

The typical form of it often occurs without any apparent cause, or results from repeated irritation or injury of the coronet. But in all cases there may be an hereditary predisposition to the malady, associated perhaps with rheumatism.

It most commonly affects light horses, those engaged in fast work. It is particularly common in the ass and mule.

The chief site of the disease is the toe and quarters.

The perioplic band appears to become more active, secreting a horny material disposed in irregular masses separated by narrow fissures resembling somewhat the bark of an old tree.

The coronary cushion in the affected part produces thickened abnormal horn of the same appearance as that formed by the perioplic ring. The skin in the vicinity may also be covered with a horny formation fissured in every direction and sometimes discharging from the cracks a purulent fluid. In old-standing cases there may be separation of the horn at the coronet.

The subcutaneous tissue becomes thickened at the level of the lesion in typical old cases, causing a swelling which projects over the hoof. Sometimes an ulcer forms between the swelling and the horn. In the subacute form accompanying a febrile disease or a skin affection the whole of the coronet is involved and reveals slight symptoms of inflammation, chiefly abnormal heat. In this case there is more or less marked lameness, characterized by a shuffling gait something like that of subacute laminitis.

In the ordinary chronic form of the disease, with local changes as described, lameness may or may not be present. When the new formation of horn on the coronet is thick, or when the wall is separated from the coronary band, lameness supervenes.

Treatment.—When apparently of constitutional origin one should treat the general affection from which the animal is suffering. If it seem to be associated with rheumatism, sodium salicylate should be prescribed. When local inflammation is present it is to be treated as such. Cold-water swabs applied to the coronets are generally useful. Afterwards the application of a hoof ointment on the coronet to promote the growth of good horn and render it supple or elastic is beneficial, such as equal parts of Stockholm tar and mutton suet boiled together, or one part of coal-tar mixed with six parts of fish-oil. Blistering the coronet may have a good effect in a case of long standing.

When the new growth of horn is thick it should be thinned to a pellicle and the weeping cracks therein should be treated with an antiseptic lotion. Ulceration should be combated by the use of a wound stimulant or caustic to excite a healthy reaction and bring about granulation and cicatrization. In all cases the horn beneath the affected part of the coronet should be made as thin as possible with the rasp to diminish the pressure and pain in the inflamed part.

Delpérier, a well-known French authority on the horse's foot, recommends washing and drying the affected part every five days, and then applying rapidly over its surface the flat portion of a red-hot firing-iron and passing its edges into the fissures. Slight repeated applications of nitric acid, more or less dilute, or of chloride of zinc (5 to 10 per cent), or of pyrogallic acid or picric acid, in saturated aqueous solution or as an ointment (1 to 10 of vaseline), has often had good results.

Necrosis of the coronet or sloughing of a portion of the coronet or subcorneal tissues may result from an open wound and infection by the necrosis bacillus.

The condition is fairly common in horses constantly standing in mud, especially in very cold, frosty weather, the severe cold diminishing the vitality or resistance of the tissues.

The lesion has been very prevalent in Army horses during the winter months as the result of the causes mentioned.

Symptoms.—The symptoms are those of intensely acute inflammation in the region of the coronet and severe lameness. An extremely painful swelling, more or less diffuse, forms here, the skin, if not pigmented, becomes dark red, and serum oozes from the surface, which becomes clammy owing to desquamation of the epithelium, which can be scraped off like a scum. The affected part then becomes insensitive, and a line of demarcation is observed between the dead and healthy tissues.

If infection does not extend beneath the horn the lameness attenuates when the scar is formed. When the subcorneal tissue is involved, the pain is more excruciating owing to compression of the inflamed part by the resistant horn, and it does not subside with the formation of the slough, which cannot be cast off on account of being confined by the horn, the result being that the organisms continue to exercise their pathogenic effects, causing further necrosis of the sensitive parts, including the laminæ or extensor pedis tendon, the lateral cartilage, or the pedal bone.

Treatment.—The treatment is that for necrosis and inflammation. The extremity of the limb should be thoroughly cleaned, the hair on the affected part clipped or shaved, the horn at the level of the lesion should be thinned to a pellicle to relieve compression, and the foot should be immersed in a warm antiseptic bath at frequent intervals to destroy the organisms and limit infection. The hot bath may be objected to on the ground that the heat favours the development of microbes, but its germicidal effect and the hyperæmia and increased phagocytosis which it produces probably discount this objection. Moreover, the moist heat softens the slough and hastens its separation when the latter does not involve important structures.

Contusion, Crushing, and Open Wounds of the Foot.—Contusion or crushing of the foot is generally caused by direct violence inflicted from above downwards on the upper part of the foot in the region of the toe, quarters, or heels, the offending agent being usually the wheel of a heavy vehicle passing over the coronet. The foot may also be crushed between the curbstone of a footpath and a heavy wheel.

Symptoms.—A slight contusion is of little consequence, causing more or less lameness, which disappears in the course of a few days. The changes in the affected part are the usual ones for a contusion, there being slight hæmorrhage or ecchymoses in the bruised tissues.

When the contusion is caused by severe violence, or when the foot is actually crushed, the animal becomes extremely lame, and if there be no breach in the horn there may be no local symptoms present, but in many instances some trace of the accident is left on the horn, or the coronet reveals symptoms of a contusion at its level, viz. heat, pain, or swelling. Pain is evinced when the injured part is pressed with the fingers. The damage done to the foot may vary in degree from slight bruising of the superficial sensitive tissues to extensive deep injury of them, with extravasation of much blood, which may collect beneath the hoof, or in the small sesamoidean sheath or even in the joint, and perhaps fracture of the pedal bone.

Although infection may be excluded, the disorganization of the tissues may be so great that return to the normal condition is impossible. Exostoses frequently form, giving rise to prominent low ring-bone causing permanent lameness. Occasionally in these accidents the hoof is completely torn off, with comparatively little injury to the deep structures of the foot. Should the lesion in the foot become septic more or less serious complications may ensue, due to necrosis of the parts affected.

Diagnosis.—If there be no history to the case and no mark of injury on the hoof diagnosis may be difficult. But, as a rule, there is some trace of the accident on the foot. When the horn of the plantar region is pared ecchymosis may be detected at the white line. These symptoms, associated with severe lameness and the acute pain evinced on percussion or compression, generally lead to a correct conclusion. It is not always easy, however, to state exactly the nature of the lesion or the extent of the injury inflicted.

When there is an open wound the structures affected may be evident and the seat of the trauma will be a guide to the parts likely to be involved. The tendons, lateral cartilages, or bones may be more or less seriously altered. Crepitation on manipulation of the foot will reveal fracture, and a synovial discharge from a wound in the coronet will be proof of an open corono-pedal joint.

Prognosis.—The prognosis depends on the gravity of the lesion. In cases of moderate contusion cure is effected after some days.

When the tissues are severely damaged there is always the danger of secondary changes occurring, such as the formation of exostoses or anchylosis of the pedal joint, causing incurable lameness. This must be kept in mind when giving an opinion as to the possible ultimate result of a severe traumatic lesion of the foot even without breach of surface.

These changes may not supervene until months have elapsed since the accident. Injury of the anterior or middle regions of the foot is more likely to have serious consequences than that confined to the region of the heel.

Deep-seated septic conditions are always serious and may defy treatment.

Infected open joint is of course hopeless, as is also compound fracture of the os pedis or navicular bone.

Treatment.—This comprises removal of the shoe, the use of antiphlogistic or antiseptic applications, and, when the lameness is very severe, placing the patient in slings.

At first immersing the foot in a cold bath or irrigating it with a constant stream of cold water, and afterwards using hot fomentations and compresses, are indicated in cases where there is no open wound. When the latter is present rigorous cleanliness and antisepsis are essential to prevent septic complications. All foreign matter and destroyed tissue must be removed, the skin of the coronet and pastern in the vicinity should be shaved, the whole hoof should be thoroughly washed and disinfected, and the foot should then be kept in a warm antiseptic bath for half an hour or an hour two or three times daily, the wound in the meantime being dressed with iodoform or some reliable application, and the hoof kept clean by being enclosed in a boot. When the wound is cicatrizing, that is, covered uniformly with granulations, dry dressing only should be used.

Separation or Avulsion of the Hoof.—Separation of the hoof may be caused by degeneration of its attachments through the agency of infection, or their rupture by mechanical violence.

Degeneration may ensue from extensive suppuration beneath the horn, and it is favoured by the use of poultices which have no antiseptic effect on bacteria. It most frequently occurs, however, as a sequel to neurectomy, especially double plantar or posterior tibial neurectomy, which entirely removes sensation from the foot. It more rarely follows median or even single plantar neurectomy.

Mechanical violence acts as a cause, when all the muscles of the limb are violently contracted in an effort to extricate the foot which has become fixed between two resistant objects, or when the foot is crushed from above downwards by a heavy weight such as a waggon-wheel passing over it and the pain thus caused makes the animal endeavour to snatch it away suddenly.

Symptoms.—The local symptoms are obvious, the sensitive tissues being all exposed and more or less injured when the result of violence. Evidence of pain is not always marked. It is surprising how slight it is in some cases. Instances are recorded where the horse continued to trot fairly well after losing one or two hoofs.

Prognosis.—When the condition is the result of degeneration or sloughing after neurectomy it is hopeless. But if the case be noticed when separation is commencing at the coronet it may be possible to arrest the process of separation by rest and antiseptic foot-baths. When the loss of the hoof is due to mechanical violence the chances of recovery depend on the amount of injury inflicted on the tissues.

In every case it will take from six to nine months for a new hoof to form. Sometimes the newly-formed horn is deformed, and occasionally, although the regenerated hoof is fairly normal in shape, lameness persists from morbid sensitiveness in the subcorneal structures. The hoof, however, may be perfectly reproduced, and even in cases where a piece of bone has been torn away with a portion of the horn-secreting membrane, recovery may occur to an extent sufficient to enable the animal to go to work.

Treatment.—Treatment comprises the removal of shreds of necrotic tissue, thoroughly cleaning and disinfecting the foot after clipping or shaving the pastern, and applying a dressing of iodoform covered with gauze and several layers of cotton-wool kept in position by a bandage, and protected from the dirt of the stable floor by a boot. The frequency of renewal of the dressing will depend on the progress of the case. Whenever it becomes moist from discharge it should be removed and replaced by a fresh application. When the tissues become covered with horn it will be sufficient to keep the foot covered with tar until the new wall is formed.

If the hæmorrhage after the accident be rather profuse it is advisable to apply a tourniquet above the fetlock to arrest it until the foot is enveloped in the compressive dressing.

Sidebones.—A sidebone is an ossified lateral cartilage of the foot.

Etiology.—The actual exciting cause of sidebones is not always clear.

The ossification of the cartilage may be due to: (1) *Heredity*, as apparently obtains in draught horses in which sidebones are very common, without any visible external cause to account for them.

(2) *A natural tendency for cartilage continuous with bone to become ossified*, as occurs in the development of bone.

(3) *Concussion* causing shock or inflammation of the bone at the base of the cartilage, stimulating proliferation of the osteoblasts, which then invade the cartilage and produce ossification therein.

The prevalence of sidebones in heavy horses, their comparative rarity in light horses, and the fact that they are seldom associated with inflammation, do not support this theory as a common cause of their occurrence. Anything which favours concussion would act as a cause under this heading; *e.g.* interference with the anti-concussion mechanism of the foot, such as contracted heels and absence of frog pressure.

Sidebones being practically confined to the fore feet is evidence in favour of the concussion theory, as is also the fact that cart horses are usually shod with calkins in front, which increase the shock on the region of the heels.

(4) *Direct violence*, such as a blow, a tread, or a weight falling on the region of the cartilage. Sidebone has often occurred in this way on the outer side of the inner limb of horses working in pairs.

Symptoms.— When the lateral cartilage becomes ossified it also increases in size, and in some instances assumes enormous dimensions. The presence of ossification is revealed by the absence of flexibility in the structure, recognized by grasping it between the finger and thumb when the foot is on and off the ground and trying to bend it. The entire cartilage is usually involved. In the early stages of the process its upper portion may not be affected. The condition is non-inflammatory, there being no evidence of pain, heat, or exudation. Sidebones *per se* are therefore not likely to be a cause of lameness, although indirectly they may act as such, especially in horses doing fast road work and in those with contracted feet, owing to their favouring concussion by preventing expansion of the posterior part of the foot and leading to corns or compression and pain of the sensitive tissue beneath the hoof. A sidebone may be present on the inside or outside of the foot or in both situations, and on one or both fore limbs. It is rare in a hind foot.

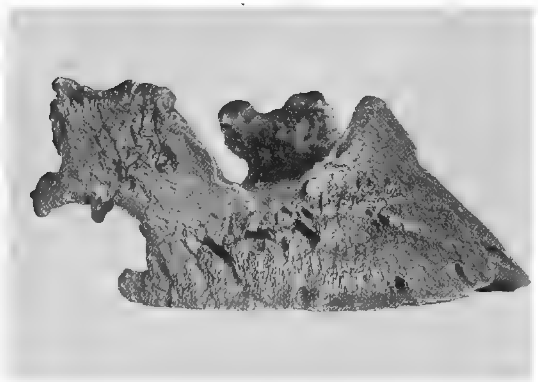

FIG. 161.—Sidebones.

Diagnosis is easy when the whole cartilage is transformed into bone, but there is sometimes difference of opinion as to whether it is partially ossified or normal, or in the former event whether it should be classed as a sidebone or not. When there is a doubt one is justified in giving the horse the benefit of it.

Prognosis.—Sidebones in horses with good open feet and doing slow work are of no consequence. They are present in a large proportion of cart horses without doing any harm.

In animals intended for fast work on the road, and in those with contracted feet, they are more serious for the reasons stated.

Treatment.—If sidebones are not associated with pain or lameness no treatment is indicated. Nothing can be done to get rid of the sidebone except operation, which is seldom desirable and can have little or no beneficial effect except the removal of an unsightly enlargement when the structure is very prominent. Counter-irritation by blistering or firing or both is sometimes done, on the assumption that lameness when present is due to chronic inflammation in the new bone.

When the hoof is contracted, grooving it is indicated, to permit of its expansion and relieve pressure on the subcorneal tissues. It can be done in two ways as follows:

First Method.—Make a vertical groove, by means of a firing iron and a searcher or a special saw, right through the wall from its coronary to its plantar aspect at the level of the anterior extremity of the sidebone. Make a similar groove at its posterior extremity directed downwards and forwards. Between these grooves make two others parallel to the posterior one.

Complete the operation by making a groove through the horn at the white line joining those in the wall. Remove the lower ends of the isolated portions of horn, so that when the shoe is in position they will not bear upon it. Fill the grooves with tar and put on a bar shoe with the bar resting on the frog and having no bearing on the parts operated upon. A leather sole is advisable but is not essential, unless the sensitive tissues have been wounded, when tar and tow should be applied beneath it to protect against infection.

Second Method.—Make a horizontal groove through the wall about half an inch below the coronet, extending from the anterior to the posterior extremity of the sidebone. From the ends of this groove make two others, converging slightly downward to the inferior aspect of the wall. Fill the grooves with tar and apply a shoe as in the first method. The horse should be exercised daily. In the course of about three weeks obvious expansion will have taken place, and in many cases the lameness will have disappeared.

There are two ways of operating for the removal of a sidebone, viz.:

1. *Partial Operation.*—Cast the horse on the opposite side after injecting a solution of cocaine over the corresponding plantar nerves. Fix the two fore limbs together above the knees by a soft rope or web in a figure-of-eight fashion. Release the affected limb from the hobble and have it held taut by means of a

rope round the hoof below the coronary band. Or the limb may be secured as for the operation for quittor. Shave and disinfect the skin over the affected region. Make a horizontal cutaneous incision at the level of the coronet, extending from the posterior to the anterior extremity of the sidebone. Bisect this by an incision extending from the upper border of the bone. Reflect the two flaps of skin thus marked out, completely exposing the outer aspect of the ossified cartilage. Saw through the latter at the level of the first incision and remove the isolated portion. Replace the flaps in position and unite them by sutures. Cover the wound with a dry antiseptic pad and bandage. The wound heals without complication by first or second intention.

2. *Radical Operation.*—Proceed as in the operation for quittor due to a diseased cartilage (*vide* "Quittor," p. 670). A drastic operation of this kind is hardly justifiable for a mere sidebone.

Diseases of the Feet in the Ox

Affections of the feet are not so common in the ox as in the horse. Even the working ox is less subject to inflammatory affections of the foot than the horse, due probably to the fact that the bovine works at a slower pace, and that its digits are more mobile and elastic than those of the equine, the result being that the shock or concussion on the foot is less. Nevertheless nearly all the diseases of the feet encountered in the horse are met with in the ox.

Sand-crack.—The definition and etiology of sand-crack are practically the same as in the horse. It is more common in the fore feet and in the outer aspect of the claw. The chief exciting cause is the force applied to the horn when weight is put on the foot, especially during the pulling of a load.

Treatment.—Treatment is on the same principles as in the horse, but clasps or horse-shoe nails for immobilizing the lips of the crack cannot be employed, the horn being too thin to bear them.

Transverse cracks parallel to the coronet are fairly common in the fore feet. They may be due to separation of the horn at the coronary band, the separation appearing afterwards as a crack when the new horn has grown down, otherwise the cause is not very evident. If the condition causes trouble its lips should be thinned as in the case of an ordinary crack.

Contusion of the Sole.—Contusion is caused by the animal treading on a hard resistant body, such as a stone projecting in its path. A long journey by road in unshod oxen or those wearing very thin shoes is a common cause of the condition, or it may be due to the shoe being convex on its upper surface and causing too much pressure on the sole. Fat cattle driven a long distance to shows or fairs are frequent sufferers, their heavy weight being a contributing cause. It is more common in the hind feet owing to the horn being thinner there.

Symptoms.—The symptoms are those of lameness and local inflammation. When the animal is left at rest he lies down almost constantly, and when standing holds the affected limb in front of the other one. On examination of the foot the seat of the lesion is detected by the usual means for ascertaining the presence of inflammation therein, viz. palpation, percussion, and paring.

When the horn is pared in a decided case of bruise it is found to be ecchymosed, and may be softened and moist from infiltration with serum, and more or less separated from the underlying tissues. If the case has been neglected the separation may be extensive, involving the greater part of the sole and perhaps part of the wall on account of the inflammation spreading and the serum or inflammatory exudate gradually insinuating itself between the horn and sensitive tissues, whose union is less intimate than in the horse. Should infection gain entrance, suppuration will supervene, and the inflammatory symptoms will be intensified, and separation of the horn will more readily occur, leading in some cases of long standing to shedding of the hoof.

Treatment.—In slight cases, where the beasts are merely foot-sore, or tender on their feet after walking a long distance by road, rest in the field or on soft litter is sufficient to bring about resolution. Otherwise the treatment is that recommended for the same lesion in the horse.

Should necrosis supervene a sinus will develop, and must be treated accordingly by removing the dead tissue, providing drainage, and dressing antiseptically.

Pricks in Shoeing.—Pricks in shoeing are more common in the ox than in the horse owing to the horn of the hoof being thinner in the former. The lesion in no practical way differs from that in the horse.

Picked-up Nail or Open Wound of the Foot.—The horn of the hoof being thinner than in the horse it is more easily penetrated by sharp bodies such as broken glass, but the commonest seat of injury in the ox is the interdigital space, where a foreign body frequently becomes lodged, such as a stone, a piece of wood, a nail, etc.

Symptoms.—The symptoms are those of a punctured wound, inflammation, and lameness.

Prognosis depends on the seat and depth of the injury. Complications which may arise are necrosis of the interdigital ligament, the tendon or bone, and septic arthritis.

Treatment is the same as that described for the horse. If arthritis supervene, or necrosis of the bone prove difficult to cure, the best treatment is to amputate the affected phalanx or phalanges, after which healing occurs without interruption. A foreign body often becomes fixed between the claws, causing pain and lameness without wounding the tissues. Its removal gives immediate relief.

Separation of the Hoof.—The hoof may be torn away from the foot under the same circumstances as in the horse. It will take three or four months for the new hoof to grow. The treatment is the same as in the horse.

Acute Laminitis.—This condition is usually the result of walking a long distance by road. It may also be caused by conveying animals long journeys by rail, the enforced standing and the shaking of the wagons accounting for the inflammation in the feet. Fat beasts like those prepared for show are predisposed to the affection owing to their great weight.

One foot or two fore or two hind feet or all the feet may be affected. The inflammation may be more marked in the internal digit.

The symptoms are similar to those in the horse, the same attitude being assumed when standing, but the attack is generally less severe in the bovine.

Febrile disturbance is present, with loss of appetite, and the animal rapidly falls away in condition.

Prognosis.—Resolution is the rule, but in severe cases more or less separation of the horn may occur. Its outset is indicated by diffuse swelling of the digital region, by prominence of the coronet, which becomes dark red, and by increased symptoms of pain. About a week after the commencement of the disease a blood-stained serum escapes between the hoof and the coronet. The separation is generally confined to the posterior region of the foot, but it may extend further and bring about shedding of the hoof. The disease seldom becomes chronic, although lameness sometimes persists from the flexor tendons becoming contracted, the abnormality being usually confined to the inner claw, with the result that excessive weight is then thrown on the other one, causing perhaps sprain of the ligaments of the fetlock and the interphalangeal articulations, which may lead to periostitis and the formation of exostoses, and giving rise to the condition sometimes spoken of as " big foot."

Treatment.—The treatment is on the same lines as in the horse. It comprises bleeding from the jugular vein, purgation by sulphate of magnesia or by the injection of arecoline and local antiphlogistic applications. One should hesitate about bleeding, owing to the risk of phlebitis. The animal should be kept on a thick bed of short litter, peat moss, or sawdust or damped chaff.

When separation of the horn occurs, antisepsis is necessary to prevent septic complications. When the sensitive tissues are covered with new horn, tar and tow covered by a piece of leather buckled round the pastern should be applied until the new wall is formed. After about a couple of months the animal may be fit to work on soft ground.

Simple dermatitis of the interdigital region, or scald, is common in the ox. It is due to the action of an irritant on the skin, such as dirty wet bedding, or mud.

Symptoms.—The symptoms are those of more or less inflammation in the interdigital region, where the skin becomes red and swollen, and lameness.

Treatment.—Remove the cause by cleaning the foot and keeping the animal in a clean place, and apply some astringent, such as a 5 per cent solution of sulphate or chloride of zinc, or sulphate of copper, or an ointment made with the latter, which soon brings about a cure.

Toxic Dermatitis.—Toxic dermatitis, which occasionally results from eating brewers' or distillers' grains, may affect the digits. It is characterized by intense inflammation of the skin, and in some cases by necrosis occurring in patches, which may extend to the deeper tissues and even involve a joint, causing septic arthritis. Constitutional symptoms of toxæmia may also be present.

Treatment.—The first indication is to remove the cause by ceasing to feed the cattle on grains. The local treatment is that for inflammation or necrosis, antiseptic applications being always necessary to counteract the effects of micro-organisms.

Chronic Vegetative or Verrucose Dermatitis.—Chronic dermatitis of the interdigital space is a chronic inflammation of the skin, which becomes thickened, red, and slightly painful. The thickening is noticed as a ridge or prominence appearing in front of the space between the claws. Later, owing to the persistence of the inflammation, granulations or vegetations, wart-like growths swollen at their summits and arranged in tufts, due to hypertrophy of the papilla of the skin, are formed. The condition is more common in the hind than in the fore feet. It may affect one or both feet. Occasionally both fore and hind feet are affected.

Etiology.—The lesion is apparently due to the constant action of an irritant on the skin of this region, as may result from an animal always standing on dirty wet bedding, or in a muddy place, especially in cold weather. Frosty dew on the grass is sometimes blamed for causing the affection in animals on pasture. There is believed to be a predisposition to the malady.

Symptoms.—In the early stages of the inflammation there is slight lameness, but this disappears after a while, when the condition becomes chronic, to reappear later when acute inflammation is produced by the vegetations becoming pinched and injured between the claws during progression, causing them to ulcerate and suppurate. The digits are pushed apart by the presence of the vegetations.

Treatment.—Treatment comprises excision of the vegetations with the knife or scissors and cauterization of their bases with a mild caustic such as silver nitrate or powdered sulphate of zinc or sulphate of copper. The hot iron lightly applied may also be used; it is caustic and hæmostatic.

It is necessary to have the animal well secured or fixed in the cast position to perform the operation, which must be done with the usual antiseptic precautions. The patient must be kept in a perfectly dry clean place until the wounds are healed. Astringent lotions such as sulphate of zinc and acetate of lead, one ounce of each to a pint of water, will be necessary during the healing process to prevent the granulations becoming exuberant, which they have a tendency to do owing to the irritation caused by the movement of the claws. When they become excessive the caustic must be applied to destroy them and make the wound level. A dry dressing of equal parts of oxide of zinc and boric acid is indicated when the wound is uniformly granulating. It is astringent and absorbent, and tends to keep the granulations firm and healthy. It is kept in contact with the wound by means of a pledget of cotton-wool or tow, maintained in position by a bandage. Copper sulphate ointment is also a very useful application when a powerful astringent is required.

Foul in the foot in its widest sense means a suppurating lesion in the interdigital region of the foot of the ox, but according to some authorities it is confined to a necrotic lesion in this situation. In either case the condition is due to injury causing a breach of surface and consequent infection of the part. It is often of the nature of carbuncle or boil, with a necrotic centre or "core."

Symptoms.—The symptoms are those of severe inflammation in the digital region and of a suppurating wound, or an abscess, or a sinus, or fistula in the interdigital space, with pronounced lameness and marked loss of condition. The sinus is due to the presence of necrotic tissue. The depth of the necrosis varies in different cases; it may be confined to the skin or affect the interdigital ligament or the tendons, or extend into the joint, causing septic arthritis, which is characterized by extreme lameness and by a fœtid, purulent synovial discharge. The necrotic centre is recognized by its yellowish greyish colour and by being surrounded by an inflammatory suppurating zone causing a line of demarcation or separation, at the level of which the dead part may be eventually cast off. The death of the tissue is due to the presence of the bacillus of necrosis.

Prognosis.—The prognosis depends on the nature of the lesion. When superficial, affecting only the skin and subcutaneous tissues, it responds promptly to simple treatment, but when the ligament or tendon undergoes necrosis resolution is very tedious, the dead tissue being slow to separate, owing to the feeble vascularity of the part; and if the joint be infected recovery is impossible without amputation of the diseased portion of the digit.

Treatment.—The treatment is as usual for a septic wound or abscess or sinus, its principles being to overcome the action of the microbes by disinfection, by providing drainage for pus, and by the removal of necrotic tissue. When these indications are effectively carried out cure will follow. When the case is recent immerse the foot in a warm antiseptic bath and apply antiseptic compresses as advised for septic foot lesions in the horse. When an abscess is present, open it; and if necrosis supervene, await spontaneous separation of the dead part while using the antiseptic applications. If the separation is too slow, operate and excise the necrotic tissue; or, if the latter is very extensive or the joint is diseased, amputate the affected part of the digit.

Contagious Foul in the Foot.—Sometimes the condition just described appears as an enzoötic in a herd and is then believed to be due to contagion, and is consequently spoken of as "contagious foul." In this case the lesion is generally one of necrosis. Several animals in a field or shed become affected about the same time. No specific organism other than the bacillus of necrosis has been found in connection with the disease, and this is a common saprophytic microbe which may gain entrance to any wound or breach of surface convenient to its habitat.

The affection is dealt with in the same way as the ordinary foul, except that special preventive measures are necessary here to arrest the spread of the disease.

The affected subjects must be isolated and the in-contacts kept under careful supervision, so as to recognize a case in its early stages should one occur. If the animals have been in a confined place such as a shed or strawyard this must be thoroughly cleaned and disinfected so as to remove the source of infection.

Fresh cattle should not be mixed with the affected herd until all trace of the disease has disappeared.

Deformity of the claws is due to the hoof becoming overgrown as the result of prolonged housing preventing wear of the horn.

Symptoms.—The toes become excessively long and are turned inwards or outwards, often overlapping in the former case. The sole becomes convex. When the deformity is well marked and allowed to persist for some time it causes pain and lameness by preventing equal distribution of weight on the foot and thereby overstretching some of the ligaments of the interphalangeal joints. The animal lies more than usual, and when standing is fidgety on its feet.

Treatment.—The treatment consists in removing the excessive growth of horn by means of a fine sharp saw and a rasp. The American toeing knife is also very suitable for this purpose. If the beast be troublesome it may be more convenient to cast him for the operation. If the sole be very prominent it is advisable to level it to a slight extent with the rasp. The edges of the horn should be rounded with the file to prevent splitting, and a dressing of tar should be applied to the hoof.

Deformity may also result from chronic laminitis, and is then characterized by rings in the wall and by convexity and thinness of the sole. It may improve with time. Little can be done to remedy it.

Amputation of the Digit.—The indications for this operation are septic arthritis of one of the interphalangeal joints or necrosis of one of the bones of the digit, which cannot be readily cured by ordinary treatment.

Control.—Cast the animal and fix the foot in a convenient position for the operation. Chloroform may be carefully administered, or cocaine may be injected over the plantar nerves. Prepare the site of operation as usual by shaving the pastern and washing and disinfecting the digit. Remove the horn by means of the rasp for a distance of about two inches below the coronet all round the affected hoof until it yields to the pressure of the finger and the level of the joint can be made out by moving the claw. Apply a tourniquet above the fetlock.

Procedure.—To remove the terminal phalanx, disarticulate the corono-pedal joint by incising all the tissues at its level with the knife below the coronary band, leaving the navicular bone *in situ* if it is not diseased.

If the os coronæ be involved, as in the case of arthritis of the corono-pedal joint, make a vertical incision through the skin and coronary band on the middle line of the anterior aspect of the digit extending to a point just above the place where the amputation is to be performed.

Reflect the two lateral flaps of skin thus mapped out. Saw through the os coronæ above its articular surface. Even when this bone is not affected it is advisable to cut off its articular extremity so as to leave a larger flap to cover the stump and to make a raw surface on the end of the latter, which will granulate more easily than a smooth, serous surface. Excise any necrotic soft tissues that are present. Remove the tourniquet and arrest the hæmorrhage by securing the bleeding vessels by torsion or ligation. Fold the flap over the stump, dress it with iodoform and boric acid, and cover it with a large pad of cotton-wool enclosed in gauze and kept in position with a bandage. Renew the dressing after three or four days, and occasionally afterwards until the wound is healed, that is, about one month after the operation.

Keep the patient in a hygienic place. The stump becomes covered with horn formed by the coronary band which was left *in situ*, and the animal recovers its normal health and suffers little inconvenience from the loss of the terminal portion of the digit.

Affections of the Feet in Sheep

Traumatic Affections.—The sheep's foot may be wounded in the same way as in other animals. A common seat of injury is the interdigital space, where infection may give rise to suppuration or necrosis, producing in the latter case a lesion similar to foul in the foot of the ox. The symptoms will vary according to the nature of the condition, those of more or less acute inflammation being always present and causing a varying degree of lameness. When necrosis supervenes there is an intensely inflammatory swelling in the digital region and the animal is unable to put the foot on the ground. The redness of the skin is very noticeable when it is not pigmented, and of course the pain on manipulation is very severe. The patient is feverish and remains lying almost constantly.

Treatment.—The treatment is the same as that described for similar conditions elsewhere. Warm antiseptic applications are indicated to overcome the action of the infecting bacteria and to hasten the removal of the scar when present. In the case of complications, such as necrosis of the phalanges or arthritis, amputation of the affected part of the digit as described for the ox is indicated.

Inflammation of the Biflex Canal.—The biflex canal is a blind passage which opens on either side of the middle line of the digit about a quarter of an inch above the entrance to the interdigital space in front, its orifice being marked by a tuft of hair.

Etiology.—Inflammation of the canal is due to irritation caused by foreign matter gaining entrance to it, such as mud and dust, etc., which may wound its lining and allow the infection which they carry with them to give rise to suppuration or necrosis.

Symptoms.—The condition resembles the one just described, but is distinguished from it by the discharge which oozes from the canal when it is compressed by the fingers. The matter which escapes is of a fatty nature and exhales a fœtid odour. In the vicinity of the passage there is marked inflammation, and when gangrene occurs its symptoms become manifest. Lameness is pronounced, the animal remains lying most of the time, and if both limbs are affected progresses on the knees. Complications may arise in neglected cases from infection extending to the deep-seated tissues.

Foot rot is a specific infectious and contagious disease of the feet in sheep.

Etiology.—The disease is due to a microorganism in the sole which gains entrance to the subcorneal tissue and there produces its pathogenic effects.

A favourite habitat of the organism is wet or marshy places, especially those soiled with an accumulation of excreta, such as dirty folds. When one case of the disease appears in such a place it rapidly spreads through the flock if preventive measures are not adopted.

The disease is rare in dry hilly districts. Allowing the hoofs to become overgrown, as often occurs in sheep on rich low-lying pastures owing to the horn not undergoing sufficient wear, favours the onset of the affection, as the superfluous horn becomes deformed, turned up at the toes, and splits, allowing dirt and infection to gain entrance to the sensitive tissues. The virulence of the causal organism becomes increased by its sojourn in the foot, thus accounting for the rapidity with which the malady spreads after a single case is established, and explaining the contagious nature of the affection. The bacillus of necrosis is usually found in the lesion, but its entrance is believed to be secondary.

Symptoms.—Lameness first attracts attention, and it varies in degree according to the stage of the disease. It is always well marked, and in typical cases the affected foot is not allowed to touch the ground. The animal commonly rests on the knees when grazing, and always does so when both fore feet are attacked. If hind and fore feet are involved the animal is almost always lying, only changing its position when it has consumed all the grass within reach.

The disease may commence in any part of the foot, wherever the bacterium has gained entrance, but it usually begins towards its inner aspect near the heel, where the first indication of it is separation of the horn exposing the sensitive tissue, which appears inflamed and covered with a whitish exudate. After a while it becomes ulcerated and angry, and excessive granulations or " proud flesh " form as the result of the irritation caused by the edges of the separated horn. The horn becomes overgrown and curved for want of wear.

If the infective process is not checked necrosis of the ligaments and tendons and arthritis may supervene.

Treatment.—The first indication is to take measures to prevent further spread of the disease by isolating the affected animals and moving the in-contact subjects from the infected area to a dry clean place after disinfecting their feet by making them walk through a bath containing a reliable disinfectant such as a 2 per cent solution of copper sulphate or Jeyes' Fluid. The sheep-fold must be thoroughly disinfected before it is used again. If the hoofs are overgrown they should be pared.

For the sheep slightly affected, walking through or standing for a while in this bath once or twice daily is sufficient to effect a cure. But those in which the disease is well established require individual treatment. The separated and overgrown horn must be removed and the inflamed tissue treated with an antiseptic or slight caustic. If there be a protruding mass of granulations it should be excised. Sulphate of copper ointment is an effective application.

In cases where cauterization is not necessary iodine ointment is preferable, made in the proportion of about 1 to 20 of lard or vaseline, or tincture of iodine may be used. It is essential that the patients be kept in a dry place after being dressed. To maintain the dressing in contact with the lesion in severe cases it is advisable to put on a leather boot, which also protects the wound from being soiled from the ground.

Dermatitis of the Interdigital Region—" Scald."—Dermatitis of the interdigital region, or " scald," sometimes affects most of the sheep or lambs in a flock. Its cause is not always very clear. It may be due to the action of frosty dews when irritation from mud cannot be blamed. The inflammation is usually fairly acute, and makes the patients very lame. The pain which it causes prevents the animals thriving and makes them lose condition. This is particularly noticeable in young lambs.

Treatment.—The condition readily responds to treatment with an astringent lotion, such as that made with sulphate of zinc and acetate of lead, one ounce of each to a quart of water. Boric acid powder has a soothing beneficial effect and may be sufficient to cure the affection. The cause, if evident, must be removed if possible.

Affections of the Feet in the Pig

The pig may suffer from sore feet as the result of being driven some distance by road, especially when the animal is fat and heavy.

The degree of inflammation which supervenes varies in different cases. It may be slight or fairly well marked, or very severe. It is manifested by the usual symptoms, which are more or less pronounced according to the nature of the case. The pig is always lame, and inclined to lie down on the road. In extreme cases suppuration may occur beneath the horn, which becomes separated, and the hoof may eventually be cast off. When the lesion is of this character there is intense inflammation of the digital region and constitutional disturbance, characterized by a febrile reaction with diminished appetite and great thirst.

Treatment.—Keep the animals at rest on soft litter and apply cold applications and astringent lotions to the feet if the inflammation be fairly severe. If the horn be separated pare away the separated portion and apply an antiseptic dressing to the exposed tissues. Laxative medicine should be administered to counteract the febrile disturbance.

Affections of the Interdigital Space.—The interdigital space may be affected with "scald," or a wound, or a suppurating or necrotic lesion, as in the sheep, each of which is treated in the same way as in the latter animal.

Affections of the Feet in the Dog and Cat

Open Wounds of the Paws.—The paw is frequently wounded by treading on a sharp body, such as a piece of broken glass, or a sharp stone or a tack or thorn, the commonest seat of injury being one of the pads, but the interdigital space may also be wounded. A foreign body may be lodged in the tissues.

The lesion will vary according to the depth and extent of the injury. It causes marked lameness.

Treatment is on the general principles of open wounds.

When the wound is punctured and small it may be necessary to examine each pad separately to find it. A foreign body should be searched for, and if found, removed. Antiseptic lotions and powder are indicated, and a pad and bandage should be applied until the wound is healed. Occasionally the wound is callous and ulcerating when submitted for treatment, especially when affecting the pads. In the latter case excessive horn may develop on parts of the wound in the form of processes with intervening sore spaces. In this case the abnormal horn should be excised and the ulcerated part cauterized with silver nitrate, after which the foot should be protected with a dry antiseptic dressing.

A circular wound of the paw or metacarpal or metatarsal region is occasionally met with as the result of a rubber ring being placed on the limb and left in position, the ring by virtue of its elasticity becoming embedded and hidden in the tissues, where it causes a suppurating wound all round the limb. In a case of this kind the indication is to search for the ring and remove it if present, when the wound will heal easily.

It may have been on the limb for months before the case is brought for treatment.

Contused wounds caused by crushing of the paw by the wheel of a vehicle passing over it are fairly common, and are usually complicated by compound fracture of one or more of the digits and destruction of a considerable amount of the soft tissues.

The treatment here is to remove shreds of dead tissue and loose pieces of bone, clip the hair in the vicinity and immerse the foot in a warm antiseptic bath repeatedly until the wound granulates, when a dry dressing will be sufficient. A pad and bandage are necessary to protect the wound in the intervals of dressing, which should be renewed once daily. If a digit or digits are irreparably damaged, amputation must be performed.

A **sinus** may form between the digits, due to the presence of a foreign body or a piece of necrotic tendon or bone in its depth. The procedure in this case is to open up the sinus with the knife, explore it to its bottom; and remove the cause of the condition.

A separated sesamoid bone loose in the tissues has been found as the cause of the condition, and its removal brought about immediate recovery after the lesion had been in existence for twelve months, causing severe lameness.

The dog's or cat's paws may be burned or scalded at fireplaces, when an inflammatory lesion is produced as described under the heading of "Burns and Scalds," and must be treated accordingly.

Inflammation of the Pads.—Inflammation of the pads in the dog often results from the animal running a long distance by road or over rough ground such as stubble or ploughed fields, especially in a dry season when the earth is hard and resistant.

Symptoms.—While the dog is running the inflammation may not be very noticeable, but after he has rested for a while it becomes obvious, the animal being very tender on his feet, showing general lameness and evidently suffering pain.

He lies stretched out, and hesitates about putting weight on the feet. Examination of the pads reveals them hot, swollen, and painful, the patient resenting their manipulation by whining or attempting to bite.

Treatment consists in rest and the use of antiphlogistic applications, cold water and astringent topics being indicated when the case is recent. If the horn be worn down to the flesh antiseptic solutions are advisable to prevent septic complications.

When the pain is severe anodyne preparations may be employed, such as a warm decoction of poppy-heads or a solution of green extract of belladonna or warm stupes, with or without the addition of a little tincture of opium.

Separation of the Nail.—The nail may be torn off or partially separated by violence in an accident, causing intense pain and lameness. When the separation is slight the nail may become adherent again; if not, it should be removed.

If the phalanx be injured it must be disarticulated and the resulting wound protected with an antiseptic dressing until it is cicatrized.

Inflammation of the Nail-matrix may be acute or chronic. It is caused by injury, viz. a contusion or an open wound, or by eczema extending from the interdigital region.

Symptoms.—A painful swelling is formed at the coronet, which may also become ulcerated or affected with little abscesses. There is marked lameness.

Treatment consists in applying warm antiseptic lotions, such as a 2 per cent solution of Jeyes' Fluid, or cresyl, or 1 to 1000 potass. permanganate, and painting the ulcers with tincture of iodine and opening abscesses and disinfecting their cavities. When the condition is one of chronic eczema the internal administration of Fowler's solution of arsenic is indicated. In rebellious cases amputation of the terminal phalanx is the best course to adopt.

Ingrowing Nails.—The nail of the dew claw, not being subjected to wear, often becomes curved and grows into the pad, causing acute pain and lameness by giving rise to a suppurating wound and by hurting the sensitive tissues. The treatment is to cut the offending nail and keep it shortened periodically, or amputate the dew claw to prevent recurrence of the condition. J. J. O'C.

LAMENESS ARISING FROM DISEASES OR ABNORMALITIES OF MUSCLES

Inflammation of muscular tissue, or myositis in its varying forms, is responsible for many of the cases of lameness encountered in veterinary practice, and it is probable that many of the so-called cases of "obscure lameness" might justly be attributed to disorders of certain muscles or groups of muscles.

Myositis may be more easily discussed under the following headings: (1) traumatic; (2) rheumatic or toxic. Parasitic myositis is of little importance in equine medicine, though sarcosporidiæ have frequently been observed living as parasitic colonies, surrounded by a tube, in the striated muscles (Miescher's tubes).

Muscular atrophy usually occurs as a sequel to myositis, particularly traumatic myositis.

Traumatic Myositis.—*Causes.*—In brief, these may be external violence or strain.

Bruising of the muscular tissues may occur from kicks, blows, or collision with moving bodies, such as vehicles. Constant or intermittent pressure, such as may be set up by badly-fitting harness, may produce inflammatory changes as in the so-called "collar lameness," due to bruising of the mastoido-humeralis.

Strains are very common, particularly in the regions of the shoulder, loins, and quarters. Excessive strain may lead to rupture of a muscle. This may be complete or only partial. Complete rupture is rare, though it has been frequently observed in the case of the flexor metatarsi, gastrocnemii, and others.

Over-exertion and bad horsemanship are the most frequent causes of myositis, whilst lack of condition and putting horses to work at too early an age predispose.

General Symptoms.—The affected muscles are sometimes swollen, though in many cases this is not apparent. They are usually held whilst at rest in a state of relaxation, but when handled the animal contracts them to a moderate extent in order to avoid the pain induced by manipulation. The muscles appear firm or even indurated in the early stages, and occasionally the surrounding tissues may be œdematous. Pain is usually evidenced upon palpation or when the limb is forcibly moved in certain directions. In myositis of the lumbar region "crouching" may often be observed when pressure is exerted upon the loins.

Movement of the affected muscles is restricted as far as possible, or the animal may even be unable to move them, even if he so wish.

The acute symptoms gradually subside, though in some cases of traumatic myositis suppuration may occur as a complication.

The usual sequel is atrophy of the affected muscles. This may be moderate, or only slightly noticeable after even severe injury, or it may be very marked, particularly when the nerve supply has been interfered with. The type of lameness is naturally dependent upon the situation and functions of the muscles affected.

Excessive strain resulting in partial rupture is accompanied by marked swelling in most cases, though this is by no means a constant symptom. Heat and pain are usually evident. The function of the muscle is temporarily suspended.

Complete rupture of a muscle is usually the result of over-extension and may be produced by forced movements of the limb, particularly when the foot or some portion of the leg is fixed, or by sudden contraction of one set of muscles without due co-ordination of those opposed to them.

It is probable that pathological degeneration in many cases precedes rupture, particularly when muscles have been the seat of changes arising from hæmoglobinuria, as may occur in the rectus femoris, vasti, and neighbouring muscles, or occasionally in those covering the outer surface of the shoulder region.

General Treatment of Myositis.—Treatment may be local only, though in some cases medicinal treatment is beneficial.

The affected muscles should be repeatedly bathed with hot water and subsequently gently rubbed with a *mild* stimulating liniment, or they may be covered with a dressing soaked in an astringent lotion. Lead and arnica lotion is useful in bruising of muscle. A liniment containing belladonna and camphor may be employed when there are severe pain and swelling. Rest is essential, particularly in myositis of the lumbar region, and in severe cases slinging may be necessary.

Internally sodium salicylate may be given with advantage in many cases. Aperients are useful, particularly in the form of small repeated doses of magnesium or sodium sulphate.

After the acute symptoms have subsided gentle exercise is beneficial and tends to prevent atrophy, which often follows myositis. Atrophy is best treated by exercise and hand-rubbing, followed by repeated blistering when necessary. Subcutaneous injections of oil of turpentine produce good results, but the subsequent swelling and pain are often undesirable. Other forms of counter-irritation produce equally satisfactory results.

Myositis of Special Muscles. Injury to the Trapezius and Rhomboideus Muscles.—This is more common in cart horses than in those of lighter breed, though it may occur in saddle horses with narrow sloping withers. The direct cause of the injury is bruising from a badly-fitting collar or saddle.

Symptoms.—Slight swelling of the muscles and pain on pressure are commonly observable, though the swelling may be covered by the mane and overlooked. There is inability to draw up the dorsal or cervical angles of the scapula, and forced abduction or elevation of the limb causes pain. Lameness is not as a rule marked, though there is usually defective action.

The condition may be followed by atrophy, but as the muscles in question have no very important function as regards locomotion, this does not usually result in lameness.

Injury to the Mastoido-humeralis.—*Causes.*—Badly-fitting collar, unequal collar pressure, efforts to start a heavy load, unequal length of traces and rough roads, may be responsible for bruising of this muscle.

Symptoms.—There is heat, pain, and tenderness of the affected part, and the animal flinches when the muscle is squeezed between the fingers and thumb. Lameness is usually only slight, excepting in neglected cases, and is manifested by shortening of the forward stride. When in harness, an attempt is made to ease the pain by carrying the affected shoulder behind the other as much as possible. This results in a " three-cornered " gait.

When the condition is neglected there is a great predisposition to the formation of a shoulder-tumour.

Sprain of the Supraspinatus and Infraspinatus.—This injury in its causation and its symptoms resembles the condition known as and presently to be described under the heading of suprascapular paralysis. It usually occurs in horses working in pairs, and is most often observed in the off-shoulder of the outside horse, according to the direction in which they turn. Animals ploughing in small fields or turning chaffing machines are particularly susceptible.

Strain of the Pectoral Muscles.—*Causes.*—Violent abduction, through falling with the fore limbs spread apart, slipping or landing badly from a jump.

Symptoms.—There is more or less difficulty in using the fore limbs. Abduction causes pain, and some swelling may be observable.

In one bilateral case recovery occurred in a week without special treatment. Di Nasso observed rupture of the serratus anticus major, subscapularis and pectoral muscles from collision with a tree. The shoulder-joint rotated outwards when weight was placed on the limb. Rigot noted rupture of the lower insertion of the subscapularis in consequence of the limb slipping outwards.

Injury to the Biceps.—The cause may be either external violence or strain through attempting to start an excessive load.

Usually the condition is complicated by injury to the trochlear bursa or shoulder articulation. The symptoms presented are pain on pressure, inability to extend the leg, and dragging of the toe. Lameness becomes most evident when the animal is turned away from the injured limb. Rupture of the biceps, and even of both muscles simultaneously, has been reported, but is exceedingly rare. Leblanc (*Journal de Med. Vet. de Lyon*) records the case of a saddle horse which suddenly fell lame on the near fore limb after having the off-fore shoe torn off by the toe of the hind foot. The lameness next day was intense. When at rest both fore feet bore equal weight. When made to walk the horse went very lame for a few steps, but if walked in a straight line the lameness diminished as the animal proceeded but became accentuated upon turning. A slight abductory movement of the shoulder was noticed when the foot came to the ground.

The biceps was contracted, hard, and very severe pain was manifested upon pressure. The lesion was confined to this muscle alone.

Leblanc considers that at the moment when the horse's progress was arrested the whole weight fell on the near fore limb and that sudden energetic contraction of the biceps caused the strain. Lameness had completely disappeared in three weeks after blistering the course of the muscle.

Sprain of the Triceps.—In many respects this resembles true radial paralysis. It is most often caused by getting the leg over the rope of the halter or into the manger, but sometimes occurs during falls and whilst jumping. Sometimes the injury is produced by getting the leg fast in a gate and struggling to get free.

Symptoms.—The horse is usually unable to bear weight on the limb unless pressure is put on the front of the forearm. The knee is held in a position of flexion and the animal knuckles over at the fetlock. The leg is brought forward with a rotary movement. In severe cases dropping of the point of the elbow is very noticeable. The condition usually wears off after a few days, without special treatment.

Rupture of the triceps has been observed as a result of turning suddenly. Marked adduction is usually evident, and in one case reported the lame leg was so much adducted that it crossed the other leg. Recovery is not probable, judging from the results of reported cases.

Bruising of the extensor muscles of the forearm may produce a condition simulating radial paralysis. Using a rope as a cross-hobble during operations as neurectomy or firing will often cause marked lameness through pressure on the extensors. The knee is flexed, the limb cannot bear weight, and the foot is dragged, with the toe resting upon the ground. There is great difficulty in advancing the limb, but there is no " dropping " of the elbow as in radial paralysis.

Strain of the flexor muscles of the forearm is sometimes seen in hunters and steeplechasers after landing from a jump.

The limb is carried stiffly and pain is exhibited, both on flexion and extension of the knee. The sequel is chronic thickening, and a bent knee often results.

The treatment should include shoeing with raised heels during the acute period, then without heels, and finally with a toe-prong to avoid contraction. Firing and blistering are usually beneficial.

Strain of the Psoas Muscles.—This is produced in heavy horses through overwork, overloading, or slipping when backing. In riding horses, jumping, carrying a heavy weight with the saddle too far back and getting " bogged," may be responsible. Some cases occur as the result of difficult parturition.

Symptoms.—There is an appearance of general stiffness of both hind limbs, which are advanced with difficulty. The horse usually travels " wide " behind, and frequently groans when turning or backing. Rectal examination and pressure on the affected muscles causes severe pain, and the animal may be unable to rise from the ground. Anal swelling may be sometimes observed.

Atrophy may result, with permanent lameness as a sequel.

The longissimus dorsi is sometimes strained in a similar manner, with marked atrophy as a result.

Strain of the Gluteal Muscles.—This may be caused by slipping during rearing or copulation, or through straining at a load. There is inflammatory swelling, followed by atrophy.

Rupture of the Rectus Femoris.—This condition has been reported on several occasions. The symptoms closely resemble those seen in crural paralysis, viz. dropping of the stifle, flexion of the limb, and dragging the toe.

Rupture of the vastus externus produces similar symptoms.

Injury to muscles in the region of the hip is accompanied by difficulty in advancing the limb, dragging the toe, and difficulty in backing. Very little weight is placed on the limb, and the condition may be confused with stifle lameness.

Rupture of the Flexor Metatarsi.—The rupture usually occurs in the tendinous portion of the muscle, either close to its origin at the lower end of the femur, or near the middle of the tibial region.

The division may be complete or partial; the latter occurs more frequently when the rupture is situated in the tibial region. The cause is usually severe strain, such as may be produced by falling with one hind foot carried backwards, over-extension during shoeing or operations on the foot, slipping on stone or paved floors, or through getting the leg over a bail. Rupture has also been observed as the result of the animal struggling whilst lying hobbled.

Symptoms.—The flexor metatarsi arises from the lower end of the femur and is inserted into the hock and upper end of the metatarsus. The tendinous portion is an inextensible cord, and so flexion of the stifle-joint must necessarily be accompanied by flexion of the hock also. Opposed to this muscle are the gastrocnemius and the flexor perforatus, the former being inserted into the tuber calcis and the latter giving off a slip to either side of this point. The gastrocnemius tendon, or, as it is sometimes called, the tendo Achillis, is quite conspicuous, and in the normal limb appears as a firm, tightly-stretched cord.

When rupture of the flexor metatarsi occurs, the tension is withdrawn and the action of the gastrocnemius muscle is unopposed. The hind limb is therefore drawn back behind the body, the hock is extended, and indeed cannot be properly flexed. The tendo Achillis then appears lengthened and falls into one or more folds, and upon moving the animal the limb may be jerked violently backwards. Occasionally swelling and pain may be observed over the site of the rupture, but more frequently there is no indication that anything is wrong at the part.

Prognosis is in the majority of cases favourable, particularly in partial rupture occurring in the tibial region. When the upper insertion is torn away from the bone, recovery is by no means so certain, and frequently a considerable exostosis develops on the lower end of the femur. As it is usually a difficult matter to decide exactly where the rupture has occurred and its extent, a guarded prognosis should be given. In favourable cases union is complete in from four to eight weeks, though when the upper insertion is torn it may require several months.

Treatment.—The first consideration is to ensure complete rest of the limb, and it is well to secure it in a position of flexion if this can be effected without unduly exciting the patient. Slinging is beneficial in quiet horses. The limb may be secured by means of a rope fastened to the animal's collar at the one end and to the metatarsus at the other, with the limb advanced a few inches in front of its fellow, but not sufficiently to prevent the foot resting on the ground. Blistering or other treatment is unnecessary, and may do harm through increasing movement by causing pain. Swelling of the part may be treated by hot fomentation if excessive and very painful.

Excessive extension of the hock-joint may persist for some weeks, but disappears upon ultimate contraction of the scar tissue. It is inadvisable to work the animal for several weeks after the disappearance of lameness.

Rupture of the Gastrocnemius Muscle or its Tendon.—This condition is distinctly rare among horses, but has frequently been observed in cattle. In many cases, however, the muscle and tendon are not affected, but the bony cap of the tuber calcis is torn off, especially in young animals in which ossification is not complete.

Complete rupture of the gastrocnemius muscle itself has been reported on several occasions, though in some of these cases the ruptured muscle, whether external or internal gastrocnemius, is not clearly indicated.

Causes.—In horses the injury may arise from suddenly being pulled up whilst at the gallop, from falling with the hind legs doubled underneath the animal, or in efforts to avoid slipping on paved or asphalt roads. Jumping has apparently accounted for several cases. In cattle, attempts to rise from unfavourable situations or riding on other cows may be responsible. In the smaller animals external violence may cause rupture of the muscle or its tendon.

Symptoms.—These are in direct contrast to those exhibited in cases of ruptured flexor metatarsi.

No weight can be placed upon the limb, whilst at each step the hock and phalanges are excessively flexed; the hock may even touch the ground when an effort is made to advance the leg. This is particularly noticeable in cattle. At the same time the ordinary taut appearance of the tendo Achillis disappears, and in all positions of the limb the tendon is relaxed. Owing to lack of support of the tuber calcis and the tendency of the unopposed flexor metatarsi to extend the stifle-joint, the hock always appears lower than its fellow.

When the rupture occurs in the tendon the separation can usually be plainly felt or even seen through the skin.

Partial rupture is indicated by lameness on attempting to place weight on the limb, and more or less pronounced flexion of the hock and fetlock joints.

Course.—In simple rupture prognosis is always more favourable than when the cap of the tuber calcis is torn off. In large animals there is difficulty in maintaining them sufficiently long in the standing position to secure union, though horses may be slung, but this does not always prevent the occurrence of laminitis in the foot of the other hind limb.

Cattle do not take kindly to slinging and usually remain in the recumbent position, which necessitates flexion of the hock-joint and is very detrimental to satisfactory union. It may be advisable to slaughter cattle according to their fitness for the butcher in other respects.

In small animals prognosis is generally favourable.

Treatment.—Horses must at once be placed in slings. Bandaging or the application of splints is a matter which must be left to the judgment of the practitioner, as horses of a quiet disposition may be benefited by their use, whilst in excitable animals interference may result in more harm than benefit. When it is decided to attempt support of the limb a plaster or pitch bandage should first be applied to the fetlock-joint, as this will materially assist in extending the hock.

The latter may be encased in a similar bandage or supported by splints, but care must be taken not to exert undue pressure on the situation of the rupture. A length of planed wood, hollowed out at the lower end to encase the flexor tendons and bearing at its upper extremity two straps of wide webbing with buckles attached, is the best form of splint. The lower end is firmly bandaged into position and the webbing is strapped around the tibia, and may be adjusted to secure the best position. Failing this, a curved splint of wood or metal may be placed in front of the limb, being first well padded and secured in position by straps or bandages.

Satisfactory cases usually require six weeks to effect union, though many cases take several months to recover.

As a last resort, operation has in some cases proved successful when the tendo Achillis has been divided. The skin is divided from above downwards, and the ends of the tendon are first pared with a scalpel and then sutured with silver wire. Deep sutures of wire may also be employed after the extremities have been joined by strong silk thread (see "Sutures," p. 570). The limb must be fixed in a position of moderate extension by splints. Excessive granulation and suppuration are the chief complications. The former may be removed with the scalpel, or rubbed with nitrate of silver occasionally. To avoid suppuration and its complications continuous irrigation with normal saline solution or very weak solution of permanganate of potash or eusol gives the best results. In dogs the limb may easily be fixed by splints and bandages in a position of moderate extension. Treatment is usually satisfactory in this animal.

Displacement or rupture of the biceps femoris muscle may occur in cattle. It is more common in working oxen, especially when in low condition.

The biceps femoris arises from the sacrum and ischium and has two insertions, one into the tibia and the other throughout almost the whole length of the muscle by means of a fibrous aponeurosis into the fascia lata of the thigh. The muscle covers the trochanter of the femur, and in thin animals this exerts doubtlessly a degree of pressure upon the aponeurosis, particularly during movement of the limb.

Slipping, falling, or heavy draught work may produce laceration or stretching of the musculo-aponeurotic layer, with the result that the trochanter becomes caught. In the case of stretching this is merely a temporary matter, and a change of position, as in travelling downhill, will usually effect release.

When, however, the aponeurosis is torn so that the trochanter protrudes through the opening the latter will be observed to be especially prominent and the former will appear as a rigid cord running parallel with the front edge of the muscle. Flexion of the femur is then impossible, and the limb is kept extended in a position similar to that seen during dislocation of the patella. In attempting to advance the limb it is carried as a whole without flexion, so that the limb appears too long and the toe is dragged along the ground. The "mowing" movement described by many authors is apparently not constant.

Treatment consists in effecting reduction of the displacement under anæsthesia; failing this, incision of the fascia in order to release the trochanter.

Rheumatic Myositis.—*Causes.*—Exposure to cold, particularly in damp weather, is one of the commonest causes. Draughts have a similar effect. Turning sweating horses to pasture, or turning them out in bad weather too soon after clipping, may give rise to the condition. Some fodders, such as heated grain, and in some cases excess of barley or maize and damaged hay, occasionally produce symptoms indistinguishable from rheumatism.

Dogs are the animals most frequently affected, pigs probably come next in order, then horses and cattle.

Certain animals seem to have a particular susceptibility to rheumatism, which they develop upon the least provocation, whilst others kept under the same conditions remain free from it.

Symptoms.—In horses the muscles of the limbs, back, and quarters are most commonly the seat of rheumatic myositis. Usually only one set is affected at a time, but the lameness usually changes from one part of the body to another. It is not at all uncommon to see a horse lame from rheumatism in one limb go sound in that particular member in the course of one or two days and suddenly develop lameness in another limb. Frequently all four are affected in turn, and usually the symptoms are confined to one at a time.

The type of lameness will depend upon the situation of the affected muscles. The attack comes on suddenly, and the animal shows great stiffness and disinclination to move. These symptoms may disappear quite as suddenly as they made their appearance, or the condition may persist for weeks or months, with frequent changes in the situation of the lameness. Lumbago is characterized by wide action, dragging gait, and a general appearance of stiffness in the hind quarters. The animal usually has difficulty in rising, and may in fact refuse or be unable to assume the standing position. Occasionally articular rheumatism accompanies rheumatic myositis.

In cattle articular and muscular rheumatism are more often associated, and the attack more frequently becomes general instead of being confined to groups of muscles. The appearance may be suggestive of laminitis.

In dogs the whole body may be affected at one time, but more commonly the muscles of one side of the neck or of the shoulder, thigh, or back are the seat of the trouble. The parts are painful on palpation, and the animal usually gives evidence of this by howling when it is handled. Sometimes the masseter and pterygoid muscles alone are affected, and the animal shrieks suddenly whilst eating.

The affected limb is usually carried when the pain is acute, but very often the attacks appear to be intermittent, so that the animal may run for some distance apparently well and will suddenly stop, hold up one foot and howl with pain.

Rheumatism of the back and loins causes the dog to carry himself stiffly, and pain is exhibited, especially whilst climbing a flight of stairs or mounting a hill.

In pigs general stiffness is the rule, particularly of the hind limbs, and the animal may exhibit symptoms resembling paraplegia arising from spinal tuberculosis.

Lesions.—In mild cases no evident change occurs in the muscles. In acute cases the muscle substance is reddened, the fibres softened and disintegrated, and lymph may flow into the interstitial spaces. In chronic cases the interstitial spaces become filled by connective tissue and the muscle fibres undergo fatty degeneration, terminating in atrophy of the muscle.

Treatment.—Local treatment must be confined to rubbing the affected parts with a mild liniment. Applications containing methyl salicylate give the best results. In horses local injection of veratrin gr. i. in alcohol ♏ xxx. daily has been recommended, but as the operation is followed by pain, the animal should be led about.

Exercise usually benefits mild cases of rheumatism, but in acute attacks the animal should be rested.

Aperients are always indicated. In horses a dose of aloes may be given, or magnesium or sodium sulphate in one or two ounce doses daily may be beneficial. Salicylate of soda or salicylic acid has for long been the sheet-anchor in the treatment of rheumatism, and it may be with advantage combined with alkalies and iodide of potash which in chronic cases is especially useful.

In dogs capsules containing methyl salicylate and colchicine give good results, or salicylate of soda may be employed. In chronic cases gum guaiacum is useful.

Pigs should receive a dose of calomel, followed by sodium salicylate in powder mixed with the food.

Cattle may receive a liberal dose of magnesium sulphate, followed by sodium salicylate and alkalies.

Myositis of Fatigue.—This condition is by no means uncommonly met with amongst equine patients. The exciting cause is overwork of a muscle or of one or more groups of muscles. Overloading or prolonged exertion, especially when the horse is in low condition or has been put to work at too early an age, may be responsible, whilst in horses in training for racing, polo, etc., it may be due to heavy demands made upon certain groups of muscles before they have become sufficiently developed to perform the work.

The symptoms vary somewhat according to the nature of the work performed and the degree of fatigue resulting. Horses which have been, in horsemen's parlance, "overdone" show symptoms of general stiffness. The feet are hardly raised from the ground but are dragged or shuffled forward. The animal appears depressed and is often feverish (103°-104° F.). Frequently the bowels are costive, particularly when the horse has sweated profusely whilst at work.

When moved from side to side or turned in short circles the stiffness becomes much more apparent, and in severe cases the animal may groan during these movements. In other cases, particularly after overloading, the symptoms may somewhat resemble those produced by laminitis, although it is quite usual for true laminitis to result from over-exertion.

The affected muscles may appear harder than normally, and are painful on palpation. Usually the extensor muscles of the limbs are involved, and frequently those of the loins and quarters. The psoas muscles may also undergo inflammatory changes, more especially amongst racehorses, steeplechasers in training, and hunters. Horses affected with myositis of fatigue show little desire to lie down. When they do so they manifest pain to an even greater extent than whilst standing, and thereby differ from horses suffering from laminitis, which, although frequently loth to lie down, invariably obtain a certain amount of relief from pain when they do so.

Treatment.—Rest is by far the most essential part of the treatment. The horse should preferably be stabled in a loose-box where he is free to move about and able to rise without difficulty, should he feel inclined to go down. The diet should be confined to loose, easily digested food, such as mashes, roots, and green food when obtainable. A gentle laxative is always advisable, and may take the form of aloes barb. ʒij.-iv., calomel ʒi. or mag. sulph. ℥ii.-iv. When the muscular soreness is very marked sod. salicylas in half-ounce doses repeated three times a day may give relief and combat the feverish symptoms which are frequently present.

The inflamed muscles may be massaged with a mild, stimulating liniment if desired, preceded, when pain is severe, by hot fomentation.

R. H. S.

LAMENESS ARISING FROM DISEASE OR INJURY OF TENDONS, TENDON-SHEATHS, AND BURSÆ

Inflammation of the Bursa of the Biceps Tendon. Bursitis Intertubercularis.—This condition is probably the most frequent cause of shoulder lameness. It occurs in two forms: the acute, which may rapidly subside or may, on the other hand, develop into chronic bursitis.

The causes of inflammation of this bursa may be severe bruising, strain of the tendinous portion of the muscle where it glides over the pulley-like surface of the bicipital groove, from slipping whilst rising or during fast paces; or infection, either local or systemic.

The lesions in acute lameness may be merely inflammatory hyperæmia of the walls of the bursa with increased secretion of synovia. Frequently flocculi are present.

In chronic bursitis, in addition to these lesions, abrasion of the cartilage of the bicipital groove occurs and exostoses may develop on the head of the humerus. Occasionally the biceps muscle itself becomes ossified, chiefly through deposition of lime salts in the fibrous bands which traverse its length. Cases have been reported in which the biceps muscle was ossified and united throughout to exostoses on the shaft of the humerus.

Symptoms.—In acute cases the animal can only raise the foot from the ground with difficulty, and this action is accompanied by manifestation of pain. There is always marked lameness when an attempt is made to advance the leg, and whilst in motion the horse carries the affected shoulder behind the level of the other and "steps short" on the lame leg. No weight is placed upon the affected member.

In backing, lameness is not usually so marked.

A characteristic of shoulder lameness is that weight is carried longer on the sound limb, which is then jerked forward quickly with a sort of "hopping" motion.

Whilst at rest the knee is usually flexed and the shoulder-joint extended somewhat, the foot being carried behind its normal level and resting on the toe. This is seen only in severe cases. Mild inflammation may not be accompanied by any noticeable symptoms whilst the animal is at rest. Sometimes the foot is held in front of the other as in "pointing," but the foot is placed squarely upon the ground and does not rest upon the toe.

Local indications of bursitis may be absent, or there may be slight swelling of the front of the shoulder, due to distension of the bursa, and when pressure is brought to bear upon it the horse may exhibit pain. Most horses will flinch, however, when the shoulder region is pinched or pressed upon with the fingers, and error in diagnosis is therefore possible. A sudden backward pull upon the limb causes great pain. In chronic cases lameness is seldom so intense, and apart from shortening of the forward stride little defect of action may be noticeable, and the animal may work for months without showing marked lameness except when travelling uphill. Whilst at rest the limb is usually carried a little behind its fellow, but the foot usually appears capable of bearing some weight. Local examination usually reveals exostosis on the front of the head of the humerus, and in severe cases the biceps tendon itself may become bony.

Sometimes the condition is bilateral, and the symptoms then bear some resemblance to laminitis. The gait is restricted in front to short, hesitating steps, whilst the hind legs are carried under the body with the object of relieving the shoulders of the weight of the body.

Treatment.—In acute bursitis the hose-pipe probably presents the most useful remedy, and cold irrigations are certainly indicated during the inflammatory stage. When lameness diminishes somewhat, counter-irritation is beneficial, and blistering is often sufficient. Rest in a level field or loose-box is essential.

In chronic cases little can be done. Repeated blistering and the actual cautery may be tried, though as a rule treatment is useless, but the course of the disease is not so rapid as might be expected, and frequently the horse remains more or less workable for some considerable time. Acute bursitis should recover in from six to eight weeks, or it may become chronic.

Old-standing cases with moderate lameness are often benefited by shoeing with thickened heels.

Strain of the Infraspinatus Tendon with Bursitis.—The outer division of the infraspinatus tendon plays over a smooth surface on the convexity of the external tuberosity of the humerus before being inserted into a rough oval mark between the summit and deltoid tubercle. Between the tendon and the convexity a synovial bursa is interposed.

As in bursitis intertubercularis, either direct violence in the form of bruising from kicks, falls or collisions, or strain of the tendon itself, may produce inflammatory changes in the walls of the bursa.

The infraspinatus is an abductor of the humerus, and according to some observers strain of the tendon is commonest in horses with narrow chests and closely-placed fore legs used for fast work. Under such circumstances the increased abduction of the shoulder necessitated by this conformation is likely to cause undue strain of the infraspinatus tendon.

Symptoms.—Lameness is most noticeable when weight is placed upon the foot and when the animal is moved in circles. In mild or subacute cases lameness may only be evident upon starting off and when turning, particularly in the same direction as the lame leg.

Swelling is not always present or visible, but there is usually atrophy of the infraspinatus resulting from lack of use of this muscle. Palpation of the diseased bursa usually causes pain.

Prognosis. — The lameness often recovers under proper treatment and has not the same tendency to become chronic as has that caused by bursitis intertubercularis. About six to eight weeks may be required to effect recovery.

Treatment.—Cold applications followed by a blister and rest in a level field are usually all that is required. If this treatment fail, the actual cautery should be employed.

Inflammation of the Subcutaneous Bursa of the Elbow. Capped Elbow.—This condition in the horse results from bruising of the subcutaneous bursa overlying the olecranon process of the ulna.

The *cause* is almost invariably bruising of the bursa and subcutaneous tissues as the result of pressure from the inside heel of the shoe or from the foot whilst the animal is lying. Occasionally, however, lack of bedding or a habit of scraping back the straw, or rough, uneven flooring may be responsible. In the latter case the resulting condition is usually somewhat different from that which is generally recognized as "capped elbow," and will be described later.

The particular manner in which the horse lies, or undue length of the inner branch of the shoe, may be predisposing factors. A somewhat uncommon cause may exist in hacks, hunters and polo ponies, when the toe of the rider's foot may cause the injury.

Symptoms. — Capped elbow may assume various appearances according to the nature and extent of the injury and its duration.

In the early stages there may be little more than an œdematous, almost painless swelling involving the point of the elbow. In other cases we may observe a very diffuse, hot and painful enlargement extending for a considerable distance above and below the elbow, and the point of the elbow itself may be disguised by the extent of the swelling. Usually the œdematous condition becomes concentrated after a few days around the site of the bursa, so that a swelling may remain as large as a cocoanut. Lameness is always severe in this type of injury, at least during the early stages.

This excessive amount of swelling with accompanying heat and pain usually points to suppuration taking place in the bursa itself. Slight œdematous swelling at the point of the elbow generally indicates distension of the bursa, not necessarily accompanied by infection. The enlargement may suppurate and burst, discharging a considerable amount of thin, bloody purulent matter, or it may assume the cystic form and become chronic, appearing as a well-defined enlargement without heat or pain, and containing a thin serous or sero-purulent fluid within one or several cavities.

The most common chronic type of capped elbow is the indurated form, which may be and usually is quite small, or it may be as large as a child's head. The enlargement is mainly due to plastic infiltration, followed by the formation of fresh connective tissue, though the exciting cause is in almost every case inflammation of the bursa (parabursitis and bursitis).

Sometimes as a result of lying without sufficient bedding, upon stones, a chronic suppurating condition results. Just below the point of the elbow a small fistula develops, usually communicating with the olecranon bursa. The condition is most often bilateral. A constant discharge of frothy, sticky pus issues from these wounds and soils the back of the limb as far as the knee or foot. In the early stages the discharge may be oily in character, but in a short time becomes purulent.

Chronic indurated capped elbow has always a tendency to again become acute unless the exciting cause, *i.e.* bruising, be removed. As horses cannot be induced to lie in an attitude different from that to which they have been accustomed, this is not an easy matter and necessitates the use of mechanical appliances, which will be discussed later.

Lameness is not usually a symptom of chronic indurated capped elbow, though it almost constantly accompanies the acute form.

Treatment.—This may be either preventive or curative. When the inner heel of the shoe is the cause of the trouble, a three-quarter shoe will be found to be beneficial, especially in the very early stages of the condition. Chronic induration may thus be avoided and relieved of pressure and further bruising. Absorption of the exudate may take place and the swelling subside.

There are many appliances on the market for the prevention of capped elbow, all of which aim at preventing the heel of the foot from coming into contact with the point of the elbow. The simplest and perhaps the most efficient of these appliances consists of a "stuffed" leather ring which is strapped around the coronet and projects sufficiently to cause a space to be left between the elbow and heel whilst the horse is lying. It is sometimes preferable to adjust the pad *above* the fetlock. As an emergency measure a thick straw band wound round the cannon at night-time answers very well when no pad is at hand. Plenty of bedding is also advisable, and when the horse is tied in a stall sufficient length of halter rein should be allowed to permit of his lying in comfort. Some horse-keepers strap a pad or cushion below the sternum at night in order to raise the level of the elbow when lying.

Curative treatment varies according to the extent and duration of the injury.

Painful œdematous swelling may be treated by cold fomentations followed by the application of astringent antiseptic lotions. Lead and alum, white lotion, lead and arnica, or strong solutions of magnesium sulphate may be employed. This treatment, together with removal of the cause, may bring about recovery.

When no improvement follows after several days, the parts may be wrapped in a warm kaolin poultice and covered by cotton-wool and some waterproof material. This may be left in position for at least twelve hours without removal. The powdered kaolin should be well rubbed down in a mortar with a little salt and treacle, warm water being subsequently added until a smooth paste is obtained. An antiseptic may be added if desired. After two or three of these poultices have been applied it will be found in most cases that a considerable reduction has occurred in the size of the swelling. The parts should then be lightly blistered with biniodide of mercury ointment applied every week or ten days.

On the other hand, should infection have occurred the fluid contents will be evident upon palpation and surgical interference becomes necessary. We are of opinion that large swellings containing a considerable quantity of serum or blood should always be opened whether infected or not. This statement may possibly meet with opposition from many veterinarians who might consider it an unwise proceeding to expose a closed sterile cavity to certain infection by incision, but the fact remains that such an extravasation area always becomes considerably organized and results in chronic induration with the production of a large, objectionable swelling which is liable at any time to become bruised by the foot or by the ground whilst the horse is lying and to again become the seat of an acute inflammation. Puncture by means of a trochar may result in the withdrawal of a large quantity of serous fluid, but, even if asepsis be maintained, the operation is invariably unsuccessful, as in the course of a few hours the cavity will be just as distended as before. We have attempted to avoid this by blistering immediately after puncture, but without success.

Free incision from the lowest part of the swelling, in an upward direction, and subsequent injection of Villate's solution or of iodine solution after free curettage of the walls of the cavity is to be recommended.

Subsequently daily exercise in a paddock assists drainage and helps in reducing the swelling.

Rainey[1] found that capped elbow amongst army horses was due to the bedding being placed too far back, with the object of preventing the horses from eating it. His treatment of the condition is worthy of mention.

After clipping off the hair from the swelling and painting with tinct. iodi he secured local anæsthesia by the use of novocaine. A Syme's abscess knife, guarded by the fingers from entering too deeply, was inserted at the highest point of the swelling and carried by one powerful vertical incision right through to the lowest point. After escape of the contents the flaps were held apart and all loose shreds and necrotic tissue were dissected away. The cavity was washed out thoroughly, plugged with wool soaked in tinct. iodi, and sutured loosely. The stitches and plug were removed in twenty-four hours and the hose-pipe turned on the wound for half an hour, after which the wound was again plugged with tinct. iodi on wool as before. This treatment was continued twice daily, the horses being kept on pillar reins.

Twenty horses with capped elbow in all stages were thus treated successfully, and were all discharged to duty within a month, healing being practically complete and little or no trace of the previous enlargement being visible.

The treatment of chronic indurated capped elbow is usually surgical, although good results have been reported from the injection of various thiosinamine preparations.

Good results often follow puncture with a scalpel to liberate the fluid contents, which may be of considerable amount in even very solid-looking enlargements. The cavity should then be plugged with wool or tow smeared with ung. hydrarg. biniodid. 1 : 8 or ung. iodi 1 : 8. This dressing should be changed daily. Pendulous enlargements may be removed by elastic ligature or ecraseur, whilst some operators recommend the clam and actual cautery.

To avoid slipping of the ligature, a couple of thin aluminium skewers may be inserted at right angles to each other above the swelling and their pointed ends coiled round in several turns. The ligature of elastic or whipcord is then affixed above these. Healing, after sloughing of the tumour, usually occupies three weeks and recovery is more rapid after surgical enucleation of the fibrous mass.

Care must be taken of the point of the olecranon whilst operating, and it is advisable thoroughly to curette the cavity to remove any secretory lining which may have been left behind. The wound should then be rendered as nearly sterile as possible by swabbing with tinct. iodi and should then be sutured. If the tumour was originally of large size the excessive skin should be partly removed and after suturing the edges the remainder should be kept in contact by means of deeply placed sutures so as to avoid the presence of a cavity which might retain the discharges. The stitches and external skin should be frequently swabbed with iodine solution.

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[1] See *V.R.* Aug. 5, 1911.

Bent Knee.—Whilst usually arising in aged or hard-worked horses from contraction of the flexor muscles of the knee or their tendons, " bent knee " may be due to various other causes. Inflammation of the carpal sheath, contracted tendons, arthritis of the knee-joint, sore shins and acute osteo-periostitis of the metacarpal region may give rise to the condition, whilst in foals and two-year-olds contraction of the flexor perforans and perforatus muscles may cause knuckling at the knee.

The condition may thus be acute or chronic, according to the cause. The chronic type is by far the more common and can only be relieved by tenotomy, *i.e.* section of the flexor tendons of the knee, though section of the perforans tendon may be necessary when the seat of the trouble is in that region. The external tendon should be first divided, and if this does not result in straightening of the knee, the middle flexor should be divided also.

Knuckling due to other causes must be treated accordingly. Young horses affected with splints should be point-fired, blistered, and turned out to graze where they will get exercise and so prevent the condition from becoming chronic, owing to contraction of the tendons of the flexors of the knee.

Distension of Tendon-Sheaths in the Carpal Region.—A dropsical condition may occur in the sheath of either the extensor tendons as they glide over the front of the knee or of the flexor tendons during their passage through the carpal arch. " Capped " or " bumped knee " may be due to subcutaneous effusion or it may involve the tendon-sheaths of the extensor pedis or extensor metacarpi magnus, usually the latter. The sheath itself may be distended with serum, or as sometimes happens, especially in long-standing cases, the enlargement may be caused by fibrous thickening of the tendon-sheath itself. Suppuration may occur, but more frequently the cavity contains serous fluid, sometimes containing a very large number of whitish bodies, in shape much resembling cucumber seeds, the so-called *Corpora oryzoidea.*

The flexor sheath at the back of the knee is supported by firm fibrous coats in the neighbourhood of the joint itself, but above and below this the sheath is not protected in this manner and is therefore liable to become distended, producing the so-called " knee-gall." This may occur on either the inner or outer side of the limb, more commonly on the inner.

The sheath of the extensor suffraginis is occasionally involved. The swelling is confined in most cases to the outside of the knee and lower end of the radius. Distension of the sheath of the oblique extensor is characterized by the presence of a sausage-shaped swelling passing obliquely over the front of the knee from the middle of the lower end of the radius as far as the head of the inner small metacarpal bone.

Causes.—Traumatic injury may produce distension of the extensor tendon-sheaths, as in " capped knee " by repeated bruising whilst lying or by striking the knee against a wall or manger. Williams stated that the condition might be caused at times by the entrance of thorns whilst hunting and jumping thorn hedges, and that these thorns might remain in for years without causing any apparent inconvenience to the animal, beyond some swelling.

Undoubtedly the most common cause of distension of the tendon-sheaths is overwork or lack of rest, whilst strain of the tendon itself may be responsible and attended by filling of the cavity with blood or serum.

It is generally agreed that hereditary influences play some part in the production of these enlargements, though what is actually transmitted is not clearly understood unless it be some defect of the synovial secreting membrane.

Symptoms.—During the acute inflammatory stage, distensions of the extensor-sheaths may cause lameness. There is swelling along the course of the affected tendon, heat, pain upon pressure and constant enlargement both whilst the foot is raised from the ground and when weight is placed upon it. Moller points out that bursal enlargements diminish when the limb is flexed or relieved of weight. The swelling is always vertical except in the case of the oblique extensor, whilst articular enlargements are usually transverse in direction.

Chronic distension of the extensor tendons seldom produces lameness, and apart from disfigurement no actual inconvenience is caused to the animal. Distension of the carpal sheath of the flexor tendons is a more serious condition. The carpo-metacarpal sheath, extending from about two inches above the carpus to near the middle of the cannon, lines the carpal arch and part of the metacarpal aponeurosis, is reflected on both tendons in the carpal arch and below on the perforans, posterior surface of the subcarpal ligament and anterior surface of the perforatus tendon. From an inch or two below the carpal arch to the upper margin of the sesamoid sheath the perforatus has no synovial on its posterior surface, and the anterior surface of this portion of the tendon is separated by loose connective tissue from the parietal synovial of the perforans.

Strain of the perforatus in the region of the knee is complicated by synovitis of the carpal sheath, which considerably aggravates the lameness and delays recovery.

Inflammation and distension of the flexor synovial sheaths may also accompany or follow various diseases, such as influenza, strangles, purpura, pneumonia, glanders, nasal catarrh, laminitis, lymphangitis, castration, wounds, etc. In foals this condition may be primary or congenital, contracted from the dam, and complicated by myositis of the flexors.

Toxic inflammation of *tendon* is denied by some who admit the occurrence of toxic synovitis of the flexor *sheaths*. Both forms are affirmed by others who maintain that the synovitis precedes the tendinitis. Symptoms and effects are variable; in foals bent knees, knuckling, or sinking of the fetlocks, œdematous tendons, swollen fetlocks and pasterns, knees, or hocks; unthrifty condition.

In older horses there is diffused painful swelling—no part thicker than another—of flexor tendons of one or both fore or hind limbs; synovitis of sesamoid, carpal, or tarsal sheath; lameness, knuckling, constantly lying down, sometimes marked sweating, and progressive emaciation.

Prognosis is generally favourable in foals; doubtful in older animals, in which rapid recovery may follow indifferent treatment, or the case, in spite of every attention, may linger for months, with thickened tendons, lameness, and chronic knuckling. Prevention has not been tried.

Carpal tenosynovitis arising from strain is almost constantly associated with thickening of the tendon as well. The symptoms will be described under "Injuries to the Flexor Tendons."

Treatment of distensions of the extensor tendons which pass over the front of the knee must depend upon the severity or absence of lameness, the nature of the work, and the value of the animal. In horses used for exhibition there may be a strong desire on the part of the owner to remove what may be actually only an eyesore. In others, in which the working capability is not diminished, interference is seldom called for.

When acute inflammation exists, cold fomentations, preferably applied by means of the hose-pipe, followed by the application of a thick layer of wool and a flannel bandage, may be sufficient, or an astringent lotion may be employed in addition. The cotton-wool pad may be soaked in a lotion containing plumbi acetas and alum, whilst some veterinarians favour the employment of a strong solution of magnesium sulphate. Hand rubbing or the use of stimulating liniments is not advisable, as an increase in the exudation may be produced by mechanical irritation.

When acute symptoms have subsided a biniodide of mercury blister is useful, as it tends to reduce the enlargement and by thickening the skin produces a local mechanical pressure which assists in absorption of the exudate.

In place of biniodide of mercury ointment we may employ a lotion containing 5 grains to the ounce of water, the solution being effected by the aid of potass. iodid., or a lotion may be used containing iodine 5 grains and hydrarg. biniodid. 5 grains to the ounce of water together with sufficient iodide of potash to produce solution. These applications should be painted over and around the affected tendon sheath daily until soreness is produced, when their use should be discontinued for a few days.

Surgical interference has found many supporters, principally on the Continent. It must be borne in mind that communication sometimes exists between the extensor sheaths and the joint capsule, and hence asepsis is indispensable and not by any means easy to secure at the time of operation or to maintain subsequently.

Withdrawal of the contents with the aspirator, followed by injection and subsequent removal of a 1 per cent iodine solution, may prove beneficial, especially if repeated on several occasions, and is not likely to be followed by any ill-effects if properly performed. Puncture of the swelling by means of a fine needle-pointed iron at red-heat, followed by squeezing out of the contents and the immediate application of a blister, may answer the same purpose, but simple puncture is seldom successful as the secreting membrane is not destroyed and the cavity refills almost at once. It is stated that injection of iodine solution at first produces a crop of granulations, and that subsequently the normal action of the secreting membrane is restored. The same is said to follow drainage produced by inserting a perforated rubber tube through the length of the swelling.

Line-firing is only of service when lameness persists, as it produces a blemish equal to that caused by the original swelling.

Very frequently in old-standing cases the contents are no longer fluid but fibrinous, and difficulty is experienced in withdrawing the contents through a trochar. In this case if removal of the enlargement be essential, nothing remains but radical operation. The skin must first be rendered as nearly aseptic as possible. An elliptical piece is then removed in the direction of the long axis of the swelling and all fibrinous clots removed. Careful curettage of the walls of the cavity should then be performed and the latter plugged with cotton-wool soaked in weak iodine solution until all hæmorrhage has ceased.

This is an important point, as otherwise the sheath becomes refilled with blood-clots. The edges must then be closely sutured with silk, but the needle should merely penetrate the skin and should not be carried through the walls of the tendon sheath or secondary infection will almost certainly occur.

The seat of operation should next be painted with iodoform collodion and bandaged over wool. The horse must be subsequently kept as still as possible, preferably in a sling, and if thought advisable the movements of the knee may be restricted by means of a splint.

The bandage and dressing may be left in position for ten days, provided asepsis has been maintained.

The treatment of toxic tenosynovitis may be local and systemic, the latter is of chief importance. For the foal, good hygiene, intensive dieting, tonics, and antiseptics; locally, plaster or starch bandages to support, or flannel bandages to protect the fetlocks. For older patients, potassium iodide, sodium salicylate, salol, quinine, antistreptococcic serum may be tried; locally, at first, warm or cold applications, compresses, fomentations; later iodine ointment, blisters, oleate of mercury, and, if required, cauterization. R. H. S.

Injuries to the Flexor Tendons and Suspensory Ligament

It is desirable briefly to recall the arrangement and relations of the structures exposed to injury.

Fore Limb.—The flexor perforans muscle, three times larger than the perforatus, arises from the humerus, radius, and ulna, and extends to near the knee where its tendon begins. The tendon passes through the carpal arch to the middle of the cannon, where it is joined by the subcarpal ligament, then downwards to the fetlock, where it passes through the perforatus ring and over the sesamoid pulley. Descending behind the pastern, under the bifid insertion of the perforatus and over the glenoid prominence and navicular bone, it is inserted on the semilunar crest of the os pedis. Slightly compressed at the knee, it is rounder at the cannon, considerably expanded and flattened at the fetlock, narrowed though still flat behind the suffraginis, at the os coronæ, to which it is loosely attached, it again expands and rapidly attains its greatest breadth at its insertion. In volume it varies little from its origin to the point of junction with the subcarpal ligament, and below this the increase is hardly noticeable owing to the gradual attenuation of the reinforcing band. At the fetlock the tendon is thicker, and its anterior surface, moulded on the sesamoid pulley, shows some of the characters of fibro-cartilage. Another increase in thickness and firmness occurs at the os coronæ. It appears to be weakest at its terminal expansion, which, however, is well supported by the posterior digital ligament.

The subcarpal or "check" ligament, a direct continuation of the posterior common ligament of the knee, is united at its origin to the anterior fibrous wall of the carpal arch and the suspensory ligament. Descending, it closely embraces the anterior surface of the perforans, which it appears to join at the middle of the cannon. In many instances their fusion is very gradually effected, as some indication of the parts of tendon and ligament can be traced to near the fetlock. The subcarpal ligament is the strongest portion of the suspensory apparatus of the fetlock.

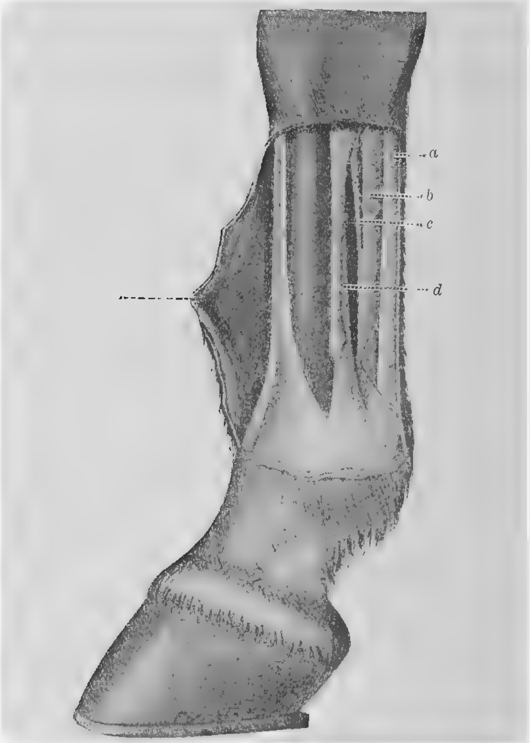

Fig. 162.—Perforatus and perforans tendons, subcarpal and suspensory ligaments.

a, perforatus; *b*, perforans; *c*, subcarpal ligament; *d*, suspensory.

The perforatus or superficial flexor muscle, arising with a portion of the perforans from the humerus, extends to near the knee where it is succeeded by tendon. In close contact throughout with the perforans, the tendo-perforatus passes through the carpal arch to near the fetlock, where it forms a sheath-like ring for the perforans, then descending and becoming somewhat broader it terminates by a bifid insertion on the os coronæ. Before entering the carpal arch the perforatus is joined by the radial ligament.

The radial ligament arises from the inner border of the posterior surface of the lower extremity of the radius and extends obliquely downward and outward to join the perforatus tendon. It is a short, rather lax fibrous band, between two and three inches long, about an inch broad, and less than half an inch thick. In Germany and France, cases of lameness have been attributed to strain of this ligament.

The suspensory ligament, arising from the lower row of carpal bones and the head of the cannon, descends between the subcarpal ligament and metacarpus to near the "buttons," where it bifurcates. Each branch is implanted on the excentric surface of the corresponding sesamoid, and a portion of each band is continued downward and forward to join the extensor pedis tendon. From its origin to the point of bifurcation the suspensory is flattened and closely applied to the cannon, its branches to the sesamoids are rounded, and the extensor bands are flat. It has a covering of connective tissue which attaches it to the cannon and flexor aponeurosis. In structure it differs from the tendons by containing fasciculi of striped muscle and some fat.

Hind Limb—Flexor Tendons.—Apart from their points of origin and a few other differences, the more important features are: the perforans in the tarsal arch is not accompanied by the perforatus; at the upper metatarsal region it is joined by the tendon of the accessory flexor muscle, and near the middle of the shank by the subtarsal ligament, which though longer is less thick or strong than the subcarpal ligament. The perforatus has a very short muscular portion, and its tendon, beginning just below the upper third of the tibia, after a winding course, reaches the point of the hock, where it forms a cap for the summit of the os calcis. Below the hock the perforatus descends the shank, as in the fore limb, to the os coronæ.

Tendon is made up of groups of parallel white fibrils, interspersed with flattened nucleated connective tissue cells, arranged in rows running in the direction of the tendon fibres. Between the bundles are interfascicular spaces, and primary and secondary connective tissue septa, continuous with the peritendinous covering. The nerves (few and non-medullated), blood-vessels, and lymphatics ramify in the septa. The subcarpal and subtarsal ligaments have thicker interfascicular septa and are more vascular than the tendons.

Peritendineum.—Each tendon has its own covering of connective tissue. This is composed of several laminæ, more or less united, closely investing the tendon, continuous inwardly with the interfascicular septa, and connected outwardly, according to the part examined, with the visceral layer of the flexor synovial sheath, the common aponeurosis, or the adjoining tendon or ligament. Between its laminæ the vessels and nerves break up to penetrate the interfascicular septa of the tendon.

Aponeurosis.—The metacarpo-phalangean or common aponeurosis furnishes a subcutaneous covering to the flexor tendons and subcarpal ligament, and separates these from the suspensory. It consists of two principal layers of fibrous tissue, united to each other and to the tendons or parietal synovial sheath by areolar tissue and continuous with the posterior wall of the carpal arch and fascia of the forearm. It forms a strong fibrous brace for the flexor tendons at the sesamoids and pastern, and supports and protects the vessels and nerves. In the hind limb the metatarso-phalangean aponeurosis is similarly arranged.

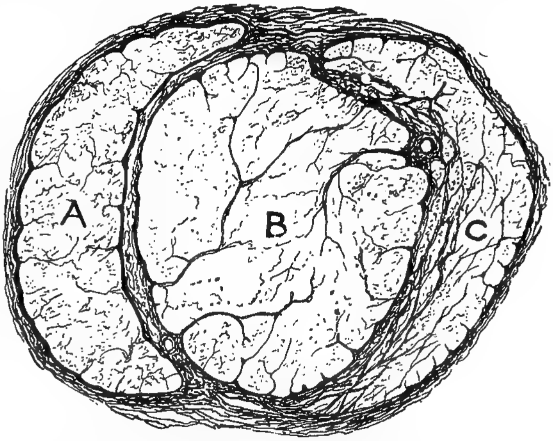

Fig. 163.—Section of the flexor tendons of a four-year-old horse, at the point of union of the subcarpal ligament and perforans.

A, perforatus; B, perforans; C, subcarpal lig. (After Pader.)

Synovial Sheaths.—Facilitate movement of the tendons, and consist of two parts continuous with each other—a parietal, lining the aponeurosis or other supporting tissue, and a visceral, investing the proper covering of the tendon. The opposed surfaces are lined with endothelium. The carpo-metacarpal sheath and the great sesamoid sheath are described on pp. 706 and 721.

Strain.—Strain, partial rupture of tendon or tendinitis, varies in gravity with the degree of injury, the position of the strain, and the cord affected. Strain may be slight and limited to a few axial or peripheral fibres (tendinitis), or severe, and involve a considerable portion of the thickness of the tendon, including its connective tissue-covering (paratendinitis). In strain affecting few or many fibres the ruptures may occur at one level (short strain), or owing to subsequent tearing or secondary ruptures at different levels, the laceration may represent a sloping breach of the tendon (long strain). In most cases there is a centre of limited rupture, but owing to consecutive inflammatory changes the distension extends above and below the seat of injury. In this way, amongst others, the diffused thickening of the subcarpal ligament and the elongation of the primary distension of "bowed" perforatus are produced.

Position of Strain.—The perforans, though far less frequently affected than is generally supposed, may be strained just under the knee, at its junction with the subcarpal ligament at the sesamoids, behind the pastern or in the "heel pan," where it is very difficult to distinguish distension of this tendon from rupture of the digital aponeurosis or bursitis of the synovial sheath. The subcarpal ligament may be strained close to its fusion with the perforans, near its origin below the knee, or towards the fetlock at its real termination. The strain may be short or limited to an inch or two of the ligament, but as there is a constant tendency to extension of the inflammation, most often the distension is diffused.

The perforatus may be strained at the knee, at the middle of the cannon, or at the fetlock. Occasionally strain occurs at other points, as within the carpal arch and at the bifurcation of the tendon behind the pastern. Strain of the radial ligament as a primary injury must be very rare, though acute bursitis of the carpal sheath, caused by bruising, sometimes extends to this ligament.

Strain of the suspensory usually occurs immediately above its bifurcation or affects the inner branch. In dilaceration or upward splitting of the suspensory the apparent strain may extend to the upper third of the ligament.

The relative frequency of strain at these sites cannot be positively stated, because cases are seldom seen early enough to permit of accurate diagnosis. But perhaps the commonest strain of the perforatus is represented by "bowed tendon" at the middle of the cannon; that of the perforans at the fetlock, and that of the subcarpal ligament near its junction with the perforans, except in cart horses, in which the lesion is oftenest near the origin of the ligament.

Regarding the comparative frequency of perforans, perforatus, subcarpal, and suspensory strain there is hardly more justification for confident assertion. However, one may say that in cart horses the subcarpal ligament is more often strained than the perforans, that by extension of inflammation the perforatus is often implicated, and that strain of the suspensory is very seldom seen. In saddle horses, racehorses, chasers, hunters, and polo ponies, strain of the perforatus or of the suspensory is more common than strain of the perforans. Anterior strains are much more frequent than posterior strains.

Statistics and published cases of flexor strain should not be accepted without caution. Repeated examination of the leg is required to distinguish the tendon strained, and in many cases some doubt remains. Poy, analysing 230 cases of anterior strain in horses engaged at fast work, gives 116 suspensory alone, 17 suspensory and one tendon, 34 perforatus, 30 both flexors, 16 subcarpal ligament, 10 subcarpal and one tendon, and 7 perforans. Barrier found the suspensory affected five times in 11 cases, and Jacoulet thirteen times in 18 cases of strain in saddle horses; and in six months at Saumur, Joly had 75 cases in horses particularly exposed to strain by attenuation of shock: 25 perforatus, 17 suspensory, 17 affecting the tissues connecting the perforatus and subcarpal, 1 perforans, and 8 affecting the tendons without possible distinction. Lesbre, from observations made in the dissecting-room, considers that the subcarpal ligament and perforans are more frequently strained than the suspensory. Other observers have found the suspensory affected twenty-four, fifty, and fifty-four times in 100 cases of strain, and Pader states that probably many cases of apparent distension of the suspensory may be due to *Filaria reticulata*, as in 37 cases of parasitic invasion of this ligament, 13 presented enlargements identical with the lesions of chronic strain. In nine years, according to Fröhner, 36,230 horses of the Prussian Army were treated for inflammation of the flexors and tendon-sheaths, and of this number 70 per cent were affected in both flexors of one limb, and 20 per cent in the suspensory. The right fore leg was affected in 43 per cent, and the left in 36 per cent of the cases. Later German statistics give, for one year, 2695 cases: 1090 both flexors, 495 suspensory alone, 401 perforans alone, 286 perforatus alone, 120 both flexors and suspensory, 49 subcarpal ligament, 1 radial ligament, and 45 synovitis or rheumatic tendinitis. In the French Army the admissions for strained tendons and fetlocks were 1080 in 1891, and 3923 in 1897. In the British Army, with an effective home strength of 21,000 horses in 1907, the admissions for strained tendons were 634, and for strained ligaments 834. Unfortunately the distribution of these strains is not given in the report from which these figures were obtained, but the small number of cases is both remarkable and gratifying.

Causes.—Predisposing or contributing and exciting causes are recognized, but as many of these appear to be interdependent they will be placed together. Defective conformation is represented by long, upright, or too oblique pasterns, buck knees, crooked legs, and tied-in tendons. Bent knees, especially when congenital, should be excepted, as they appear to save the tendons, and in this belief some owners and trainers prefer horses that lean a little at the knees. Tendons, though thick and apparently strong, may be weak, defective in quality, of unequal density, less resistant, and more liable to strain; these defects being due to heredity, breeding, rearing, or dieting. Other causes are premature work or training before complete growth or consolidation of the tendons and ligaments; forced training or pushing the preparation of the young horse; nervous excitability in thoroughbred and some other horses, by inducing more energetic efforts; fast work, especially racing, chasing, hunting, and trotting (perforatus and suspensory strains); muscular fatigue towards the finish of a fast-run race or in galloping too far, and weak flabby muscles, by relaxing the flexors and too suddenly throwing the support of the fetlock on the tendons; heavy draught work, starting or backing a load, holding back going down hill, and shunting (subcarpal or perforans strain); antecedent disease, adhesions, with or without shortening, worn tendons, chronic disease of tendon, aponeurosis, or synovial sheath; hard ground, by increasing the flexion of the pastern and the tension of suspensory and perforatus; heavy holding ground by detaining the foot, impeding movement and increasing effort; ground with a soft or movable surface-layer, as grass after rain, and wood or asphalt when wet or greasy, by causing slipping; ringbone and enlargements of the pastern by hindering or preventing movement of the joints and consequent relaxation of the tendons (perforans strain); long toes and low heels and shoeing with tips predispose to strain of perforans and perforatus. Slipping in the stable or on the road, a false step, and in a tired horse a sudden acceleration of speed may cause strain.

In forming an estimate of the merits of these causes, attention should be given to the action of the fetlock and pastern. The fetlock, with its angle open in front to about 150°, is sustained by the suspensory and supported by the flexor tendons. The suspensory yields a little when the fetlock sinks and regains its former length when the fetlock rises. In movement, the tension of the suspensory is in proportion to the degree of dorsal flexion of the fetlock, and if it is elastic the property of stretching is due to the muscular fasciculi incorporated with its fibrous tissue. Immediate post-mortem examination of the suspensory reveals no sign of special elasticity, and in the thoroughbred during movement it appears to be rather thicker when tense than when relaxed. Pader holds that the suspensory is not more elastic than the tendons, and Lesbre suggests that the lengthening or yielding of this ligament is more apparent than real because of its bifurcation and the position of its attachments to the pastern. Implanted on the free or outer side of the sesamoids, it acts like a cord suspending the pulley by its axis, and when the fetlock descends the sesamoid mass passes between the branches of the ligament. However this may be, the suspensory acts by a direct pull on the sesamoids, while the flexor tendons furnish a movable support to the fetlock, and together tendons and suspensory may be regarded as a single power acting at the sesamoids on the lever of the pastern to oppose the descent of the fetlock and closure of its angle in front. In the standing position the weight transmitted through the cannon falls on the fetlock, where it meets the inclined articular surface of the pastern and is resolved into two parts, one perpendicular to the inclined surface, the other parallel to it. The perpendicular weight exerts its pressure on the pastern bones, which neutralize it by their resistance, while the other part, which abuts behind on the sesamoids, tends to force the fetlock downwards by inducing oscillation of the pastern lever with consecutive closing of the metacarpo-phalangean angle. This tendency is overcome by the tension of the suspensory apparatus, which keeps the fetlock in position and preserves its normal angle. In locomotion, when the foot comes to the ground, the pressure supported by the fetlock is represented by the weight of the body plus the force of inertia resulting from the acquired speed. The more rapid the pace the greater the pressure. And while the foot is in contact with the ground the fetlock, at first, is a centre of attenuation of shock and afterwards a centre of impulsion. Its mechanism was investigated in 1891 by Barrier and Siedamgrotzky. Working independently, with the assistance of instantaneous photography, they arrived at very similar conclusions, which as regards the causation of strain may be shortly stated: When the foot is coming to the ground, the oblique cannon forms with the pastern a straight line (Fig. 164, 2). When the foot is in support the cannon becomes vertical, while the pastern approaches more or less the horizontal. In virtue of the marked dorsal flexion of the fetlock, the pastern or phalangean lever oscillates in two different directions: forwards and upwards on the cannon and downwards on the os pedis and navicular. These two movements of oscillation are absolutely simultaneous, and they produce at once closing of the angle of the fetlock and flexion of the coffin-joint (Fig. 164, 3). But the effect of this closing of angles is different on each flexor tendon. The perforans, representing a cord extending from the head of the cannon (origin of subcarpal ligament) to the os pedis, is relaxed, the inflexion of the pastern having shortened the distance between its two points of insertion. The perforatus, extending from the radial ligament to the base of the pastern, is made tense, in consequence of the separation of its points of attachment, and for the same reason it more closely braces the fetlock. Towards the middle of this stage the suspensory reaches its maximum of tension and is most exposed to rupture.

From this moment of the support, the angle of the fetlock effects a sort of forward oscillation, the pastern straightens and the flexion of the coffin-joint progressively diminishes, whilst the cannon is inclined forwards (Fig. 164, 4). This oscillation of the fetlock and the simultaneous straightening of the pastern have the effect in a fast pace—as a striding gallop—of effacing the angle which was formed at the hoof, and of producing a little greater closing of the metacarpo-phalangean angle. Under the influence of these two causes the tendons are immediately stretched and quickly reach the limit of their extension. The more extensive the oscillation of the angle of the fetlock on the articulation of the foot the greater the tension of the subcarpal ligament, so that at this instant the least supplementary effort may cause a rupture.

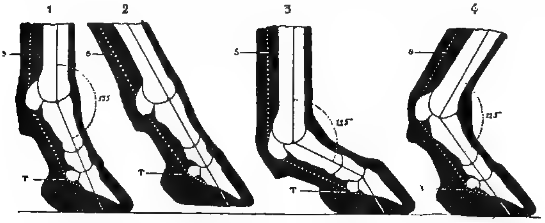

Fig. 164.—Respective values of the articular angles of the fetlock and the foot during rest and movement. (Instantaneous photographs, after Barrier.)

S, suspensory ; T, perforans ; 1, rest; angle of the fetlock 155°, angle of the foot 0° ; 2, coming to the ground ; preceding angles effaced ; 3, middle of the support ; angle of the fetlock 115°, suspensory in tension ; angle of the foot 147°, perforans relaxed ; 4, finish of the support ; angle of the fetlock 115°, suspensory still tense ; angle of the foot effaced, tendons fully stretched.

Inferentially these observations may be summarized : (*a*) strain of the suspensory is produced by excessive tension (paratonia) of the ligament at the moment of greatest dorsal flexion of the fetlock, when by inflexion of the coffin-joint the semilunar crest is brought nearer the sesamoid pulley and the perforans is relaxed (Fig. 164, 3). (*b*) The perforatus may be strained in the same way as the suspensory, with which it shares the charge of supporting the fetlock when the foot comes to the ground. (*c*) Strain of the subcarpal ligament or perforans is produced by excessive tension (paratonia) of the tendon at the moment of hyper-extension of the pastern during impulsion in fast work or in forced draught (Fig. 164, 4).

In the first stage of the support (Fig. 164, 3) some hesitation arises regarding the action of the perforans and subcarpal and their escape from strain. The very limited relaxation of the perforans tendon at the coffin-joint can hardly be sufficient to permit the angle of the fetlock to close to the extent seen in racing, when the ergot almost touches the ground. The tendon is inextensible, and its apparent elongation when the fetlock descends should be referred to the *muscle*. The subcarpal ligament is not constantly tense, and it is reasonable to suppose that the perforans muscle is stretched before this ligament is called upon to share the pull on the tendon. In racing and similar fast paces muscles sooner or later become fatigued, and as they are not continuously contracted, when strain of the subcarpal does happen at this stage, most likely the injury occurs during relaxation of the muscle, when the ligament, unassisted by muscular contraction, is in extreme tension.

Regarding strain of the perforatus the operation of the cause is not clear. At the fetlock this tendon moves freely on the perforans, and, according to Joly, with the advantage of having watched the action of the naked flexors in a living horse, the perforatus begins to move and comes to rest a little sooner than the perforans, which appears to continue the movement. The perforatus muscle is small, presumably weak and easily stretched, and the radial or check ligament is lax enough to allow for elongation under tension. No doubt partial rupture of this tendon sometimes occurs, but clinical observation suggests that the usual distension—" bowed tendon "—is gradually produced by repeated limited laceration of the peritendinous covering, and that later the body of the tendon becomes affected by extension from the peritendineum (paratendinitis).

Effects of Strain.—Coleman taught that sprain is " an inflammation of the cellular tissue connecting the perforatus and perforans together " ; and Percivall, while holding that tendons are incapable of extension and are too firm and strong to sustain hurt from common accident, recognized the fact that they are surrounded by a soft, delicate tissue which must, every time they are forcibly pulled or stretched, be extremely liable to laceration. Since then—excepting those who, perhaps too seriously interpreting the words of the preacher, " he that increaseth knowledge, increaseth sorrow," have been content with offering opinions—very few have taken the trouble to inquire into the nature of strain, and Pader, Veterinary-Major in the

French Army, has done more than any other to explain the pathology of tendinitis.

Excessive tension of a tendon causes rupture with retraction of fasciculi, laceration of the peritendinous covering and interfascicular septa, extravasation, and sero-sanguineous exudation. The exudate fills the interfascicular spaces and distends the areolar septa, the hitherto quiescent tendon cells increase in size and become active, while the damaged fibres are partially converted into a structureless hyaline pulp. Inflammatory reaction is set up, and in the reparative process the breach in the tendon is made good by granulation tissue, which is formed by the agency of the tendon cells and the fibroblasts of the connective tissue adjacent to the lesion. Eventually the new-formed tissue undergoes cicatricial contraction. Though tendinitis, caused by strain, is an aseptic process it nearly always produces permanent distension at the seat of injury. Resolution is a possible termination, but in most cases of sufficient intensity to attract attention, repair is imperfect, and after apparent recovery it is exceptional to find the tendon normal or quite free from adventitious growth. As a rule there remains a nodular or diffused thickening of the tendon or peritendinous covering. A tendon once inflamed is predisposed to relapse, and too frequently, owing to insufficient rest, to position, or to persistent irritation, the result is chronic tendinitis.

Post-mortem examination of a chronic or indurated strain of the subcarpal ligament shows, in addition to remarkable intrinsic distension of the ligament, considerable peripheral increase from new formation of connective tissue. The suspensory lying in front is not involved, but the borders of the subcarpal ligament are firmly united to the perforatus and its covering by the enormously thickened aponeurosis. This union forms a tube for the perforans, which remains free within the synovial sheath. At the point where the subcarpal joins this tendon, and below to a variable extent, the perforans is more or less distended, but above, within the carpal sheath, the tendon may be normal, atrophied, or hypertrophied according to the intensity and duration of the inflammation, and the degree of compression exerted by the surrounding new fibrous growth.

Partial atrophy of the perforans may result from chronic inflammation of either the subcarpal ligament or perforatus. Hypertrophy may be due to a compensatory cause, the perforans, owing to failure of the perforatus or one of the ligaments, being more actively engaged in supporting weight. But sometimes the increase in thickness is pathological and due to tendinitis either primary or arising by extension from the subcarpal ligament, perforatus, or aponeurosis. The metacarpal vessels and nerves running through the thick fibrous growth under stress of increasing compression may be injured, and in fact the wall of the metacarpal artery is much thickened, and the nerves, including the branch which crosses the perforatus, are expanded and flattened, but otherwise they appear normal. Sclerosis, arteritis, and phlebitis of the vessels, and sclerosis and perifascicular exudation of the nerves, have been observed by Pader, and he suggests that possibly this interstitial neuritis may contribute to the lameness.

Similar peritendinous alterations with ultimate ossification of the fibrous growth occur in connection with chronic tendinitis of the perforans at the fetlock, usually of the hind limb. The rupture occurs between the sesamoids and the os coronæ, where the perforans is constricted and relatively weak. The tendon presents a diffused distension extending above the sesamoids and forming a notable prominence behind the pastern. The synovial sheath and aponeurosis, inflamed and thickened, appear more seriously affected than the tendon. Some observers, probably impressed by the more obvious lesion, maintain that synovitis precedes the tendinitis; but Siedamgrotzky, after numerous investigations, held that in every case of chronic inflammation of the sesamoid sheath accompanied by lameness and tumefaction, the perforans has been partially ruptured, and that the synovitis is the result of extension from the tendon. Post-mortem examination of a chronic case does not reveal the order of attack. Both tendons and the synovial sheath may be affected, the perforans by distension, the perforatus by peritendinous increase, and sometimes the aponeurosis shows more extensive alteration than either the tendons or synovial sheath. In the fore limb, at the perforatus ring, the perforans alone may be distended coincidently with inflammation of the sesamoid sheath. In this case the synovitis appears to precede the tendinitis, which invades the sesamoid surface of the tendon. Inflammation of the synovial lining of the carpal sheath is usually associated with strain of the flexor tendons or check ligament.

There is often marked lameness with inability to flex the limb. A firm swelling appears at the upper part of the back of the knee-joint, usually at the inside, and a second enlargement below the knee, extending as far down as the middle of the cannon. The two are actually confluent, but appear to be divided, owing to the presence of firm fibrous bands which support the carpal sheath behind the knee. The condition is sometimes referred to as "knee thoroughpin."

Tendinitis of the perforatus at the middle of the cannon usually arises from a very limited initial injury of the tendon or the peritendinous covering. At first the leg is merely filled or œdematous over a portion of the tendon, and the lameness, not very marked, disappears with the swelling under rest and bandaging. Gradually, however, the tendinitis extends, the swelling becomes firmer, and persists in spite of bandages and simple remedies. At this stage careful treatment may arrest the progress of the inflammation, but in most cases insufficiently rested the peritendinitis invades the aponeurosis, the borders of the perforatus become united to the subcarpal ligament, and permanent distension and adhesions extend far beyond the seat of primary injury.

In high strain and in strain at the fetlock, the distension of the perforatus is complicated by synovitis of the carpal or sesamoid sheath, which always aggravates the lameness and retards recovery.

Here mention may be made of those cases of "diffused thickening of the flexor tendons" of one or both fore or hind limbs. The leg from knee or hock to fetlock is enlarged over the tendons by persistent, firm, not very sensitive swelling, without abrasion or lameness, and causing no inconvenience beyond raising the heels slightly off the ground. In this condition the tendons are not really thickened, but the aponeurosis and peritendinous coverings form a dense fibrous shield which appears to interfere very little with the movement of the flexors. What is the cause? Wear and tear, constitutional weakness, heredity, or what? Though sometimes referred to rheumatism, the alteration gradually produced is so painless in its progress and effects that one hesitates to accept this explanation. A more feasible answer may be found in the effects of excessive work, and probably the chronic peritendinous thickening arises from the stress of constant heavy traction in cart horses, and from jumping and prolonged galloping in hunters and other saddle horses.

In strain of the suspensory above its bifurcation the distension at first is lax and compressible, but as repair advances the injured part becomes harder. Its connective-tissue covering participates in the inflammatory process, but the peripheral increase is less extensive than in flexor strain. The recessed position of this portion of the ligament and its separation from the subcarpal and tendons by the aponeurosis and a connective tissue layer possibly explain the frequent escape of the tendons from invasion. But in strain of one of its branches the consecutive inflammation not only distends the suspensory but extends through the medium of the aponeurosis to the perforatus and lateral sesamoid ligament and produces one-sided chronic enlargement of the fetlock.

Parasitic invasion of the suspensory and perforatus has been observed in Austria, Russia, and the South of France. The parasite (*Filaria reticulata*) in excavating galleries causes the formation of painless nodular enlargement of the ligament, which may be mistaken for old-standing distension.

Filariasis of the suspensory has been investigated in Russia by Tchulovski and in France by Pader, and a full description of the condition will be found in the *Journal of Comparative Pathology* for December 1908. In one district Pader examined, post-mortem, 43 horses, asses and mules, and found 35 affected in various degrees; and Tchulovski had 51 cases in 53 horses examined at Kazan. Apparently, while active, the parasites weaken the resistance of the suspensory and predispose it to strain or rupture. After a time the parasites perish and the lesions are repaired, but the ligament remains more or less enlarged. So far the writer has not been able to find a suspensory with the parasite. In a few foreign-bred ponies the ligament of one or both fore legs has been found nodulated as in filariasis, but the cause could not be ascertained. In this country owners are not readily persuaded to sacrifice useful animals to gratify surgical curiosity.

Symptoms and Diagnosis.—The symptoms of strain being familiar, only a few will be referred to here. Diagnosis bristles with difficulties fully appreciated by the writer, who being himself unable to see clearly, can hardly show the way to others. Every strain is accompanied by the usual signs of inflammation, and soon after the injury swelling, pain, and increased heat of the strained part are discoverable. These symptoms, as well as lameness, vary not only with the measure of the inflammation but to some extent with the position of the strain and the tendon or ligament involved. Lameness is more marked in subcarpal or perforans strain than in strain of the suspensory or perforatus. Severe strain of the subcarpal or perforans appears to be much more painful than other strains of equal extent or intensity. The horse walks lame and may be unable to trot. In strain of the perforatus ("bowed tendon") or suspensory, walking may be free from nodding, and trotting may be comparatively easy. The difference in degree of the lameness exhibited in the two cases is due partly to function, and partly to synovitis, which is almost a constant accompaniment of perforans strain and only an occasional complication of strain of the perforatus. Excepting an inch or two at the mid-cannon and at its termination, the perforans tendon throughout is invested by synovial membrane, while the perforatus is only so covered in places. The horse's action may be suggestive, but in few cases does action alone warrant the diagnosis of strained tendon. Inspection of the lame leg, except in recent bowed tendon, may mislead, and a case sometimes occurs in which the exception should be disregarded to avoid error. Painful œdema over the tendons is helpful, but its many causes unconnected with strain should be considered. Manipulation of the injured region is most useful in forming an opinion of the nature of the case, and there is no better method of arriving at a differential diagnosis of the cord affected. In practice the advantage of distinguishing the strained from the unstrained tendon or ligament may not be very great; treatment varies very little, and often the diagnosis "strained tendon" is sufficient, and perhaps it is fortunate that the horse owner in this particular is not more exacting. Differential diagnosis of many cases is extremely difficult, and of some impossible, even after repeated examination of the leg. But bearing in mind that in most of the commoner strains the inflamed peritendinous tissues establish an intimate and more or less extensive connection between the tendons, a comprehensive view may be taken by anticipating probable extension of the tendinitis to parts which are neither distinctly normal nor yet clearly affected. In this way lies safety in diagnosis. The observer may be confident and fully justified in diagnosing strain of the subcarpal ligament, and at the same time quite unable positively to state whether or not the perforatus or perforans is also implicated, but his experience of similar cases should enable him to affirm that the perforatus will not escape.

In diagnosing strain just under the knee, the subcarpal, perforans, perforatus, carpal sheath, and the aponeurosis merit consideration.

Firm painful swelling near the cannon and extending four or five inches downwards usually denotes, in the cart horse, subcarpal strain, and in others, strain of the perforans with synovitis of the carpal sheath. Superficial swelling extending upwards and distending the carpal arch generally arises from perforatus strain, and when the tumefaction is one-sided and very painful, external injury may be the cause. Clipping the hair over the tendons facilitates further examination. By flexing the knee and tracing singly the ligament and tendons, a centre of tendinitis will be discovered. Later, in a week or two, the inflammation having extended, while a diagnosis of strain can be safely made, uncertainty remains as to the cord primarily or mainly affected. In strain of the subcarpal ligament at its junction with the perforans, the resulting distension appears to involve the tendon as well as the ligament, but post-mortem examination shows, at least in a few cases, that the lesion is restricted to the portion of ligament that is joined to the tendon. In young horses lame from high splint, œdema may extend to the adjoining aponeurosis and excite suspicion of flexor strain. Doubt will be satisfied by applying a bandage, which generally removes the swelling.

Strain of the perforatus at the middle of the cannon may develop insidiously, or it may be shown by immediate conspicuous engorgement over the tendon. The slowly progressive case at first may be overlooked, because there is very little interference with function, but the other at once attracts attention. The horse is very lame, and the swelling, quickly formed, may have to be reduced before the nature of the injury can be ascertained. Usually the strain is severe and accompanied by acute tendinitis, which rapidly produces fusiform deformity of the tendon with extensive peritendinous thickening. The progressive case begins by the formation of a warm, slightly painful, compressible swelling over the tendon. This may be attributed to a blow, but there is no abrasion; though the absence of signs of contusion on a leg bandaged at work should not altogether exclude external injury as a possible cause. If arising from strain the œdema diminishes or disappears under bandages and re-forms when the leg is left uncovered. Lameness is hardly noticeable, and the horse may not be rested. In time, depending on the degree of injury and the horse's work or exercise, the swelling extends, becomes harder, and does not yield to lotions or bandaging. The tendon and its covering are inflamed, and short or elongated permanent distension will result. Owing to various causes the horse is kept going. Meanwhile peritendinitis extends, further laceration may occur, adhesions form, and eventually the condition of the leg and increasing lameness enforce rest and treatment.

Differential diagnosis of strain at the fetlock, fore or hind, is seldom easy. Occasionally, and only at the beginning, a case which appears to represent a flexor strain may be entirely due to synovitis of the sesamoid sheath, and as the perforans cannot long escape invasion, the cause of lameness may be puzzling. The condition of the inflamed synovial sheath hinders exploration of the tendons. Both flexors may convey the impression of distension, while only one is inflamed; and in the chronic case paratendinitis (aponeurosis and synovial sheath) prevents intimate examination of the parts. Sometimes the position of the fetlock or the heels assists in the diagnosis of suspected flexor strain. Synovitis with knuckling, the foot resting flat on the ground, suggests perforans strain; synovitis with raised heels points to perforatus strain and paratendinitis or aponeurotic thickening; and synovitis with knuckling and raised heels to tendinitis of both flexors. Firm painful swelling over the flexors below the sesamoids usually arises from perforans strain, complicated by synovitis and paratendinitis, and much of the thickening or bulging behind the pastern proceeds from changes in the aponeurosis. In some cases there is distension of the inferior sesamoid ligaments.

Recent suspensory strain may be recognized very easily, but diagnosis of the chronic case of branch strain may be rendered very difficult owing to adventitious growth and adhesions. The affected ligament should be traced in the raised limb and compared with a healthy one. Distension caused by strain is rapidly formed and always more or less diffused. Lameness varies, and considering the condition of the ligament, it may be little marked. After rest and treatment functional recovery is the rule.

Prognosis of Strain.—The discussion of prognosis, in the absence of the horse, is unlikely to be profitable, and this part of the subject will be passed with the remark that of the various strains, considered functionally and economically, subcarpal is the most serious. The others, placed in the order of diminishing importance, are perforans, perforatus, suspensory. This order should not be regarded as inflexible, but merely as the outcome of experience of average cases.

Treatment.—Treatment of a recent case comprises rest, which too often is ridiculously short and inadequate, raising the heels, warm fomentations to mitigate pain, ease tension, and promote absorption; douching with cold water, hosing the leg, or applying lotions of ammonium chloride, magnesium sulphate, sodium chloride, zinc acetate, alum, or lead subacetate, to remove congestion, lower local temperature, modify the inflammation, and hasten absorption of the exudate. Ice poultices and continuous irrigation with cold water have similar effects, while warm moist compresses renewed every half hour are strongly recommended by Moller, and dry uniform compression by means of cotton-wool and bandages by Hunting. A thick layer of a mixture of hard and soft paraffin containing white lead or finely powdered Epsom salt applied to the strain and covered with cotton-wool and a bandage is said to be beneficial. Evaporating lotions, anodyne liniments, and astringent pastes are also employed; but probably encasing the shank with cotton-wool held securely in position by an elastic or rubber bandage and keeping the horse as far as possible at rest will be found equally efficacious. The early treatment of an acute case continued for from four to ten days or longer lessens or removes the œdema, heat and pain, and isolates the firm, more or less extensive and still sensitive distension, which is now in process of repair. For some time the lesion remains apparently stationary, and though the preliminary remedies, supplemented by hand-rubbing or massage, may be continued, a cold-water bandage or a compress soaked in saturated solution of Epsom salt applied to the leg night and day, may be found sufficient to prepare the case for more active treatment.

Massage as a therapeutic measure in human and veterinary practice was introduced by Girard, veterinary surgeon to the Imperial Guard of France, in 1857, and its rational application to strained tendons has been explained by Waldteufel. He uses an antiseptic pomade composed of lard, 250 parts, cresyl, 10 parts, to which water, 100 parts, is gradually added and thoroughly mixed to form a cream. After smearing the swollen part with the pomade, massage proceeds by very gently rubbing, from below upwards, all round the strain to unload the vessels and to remove extravasation. Progressive pressure with the palm or the palmar surface of the thumb and fingers should then be applied to the strained or painful parts, and always in the direction of venous return. After rubbing for fifteen minutes or so the part becomes softer and less sensitive. Then the pressure should be stronger and the movements of the hand accelerated for a further fifteen minutes. Massage should be practised for half an hour once or twice daily according to the case, and in the intervals the leg should be bandaged. This treatment gives excellent results in cases associated with much œdema.

Stimulation or resolvent treatment is indicated in the stationary period while repair is taking place, or in two or three weeks after the accident, but some practitioners, immediately after diagnosis, apply a mercurial all over the strained region. The favourite agent is oleate of mercury or diluted mercurial ointment.

Frohner recommends the treatment which he saw employed at the Imperial Stables, Vienna. After the usual preliminary applications to the strained part, the hair is clipped and the skin washed and disinfected, then biniodide of mercury ointment (1 to 4 or 5) is rubbed in thoroughly for fifteen minutes, and covered with absorbent cotton and an ordinary bandage, which are allowed to remain in position for two weeks. After twenty-four hours the bandage becomes moistened with exudate which soon dries. By resorting to this method the application of the cautery to chronic cases may not be required.

Cagny, with a large racing practice, in the treatment of strain, in place of vesicants and sometimes firing, employs subcutaneous injection of a drachm of rectified oil of turpentine to which he adds a small proportion (1 in 50) of a 5 per cent alcoholic solution of guaiacol, to render it aseptic and to diminish the pain following the injection. This method produces much additional swelling and frequently abscess formation, which, however, is seldom serious. He claims that the results are as good as those obtained from vesicants or firing, the leg is not permanently blemished, and this remedy is more easily applied than the cautery, but he admits that some horses are much agitated for several hours after injection, a few refusing to feed for two or three days; that the œdema may be so enormous as to prevent all movement for a week, and that it is slow in disappearing.

For perforatus strain, Joly, of the Training School, Saumur, in 1901 introduced the treatment by peritendinous insufflation of filtered air, followed by massage. The operation, carried out with due regard to antiseptic precautions, may be performed in the standing or recumbent position. A tourniquet is applied to the forearm. The air, drawn through iodoform gauze, is slowly injected by means of a Potain's aspirator furnished with a fine needle, which is pushed into the subcutaneous tissues over the distension on the posterior line of the leg. When the air has penetrated the healthy, œdematous or indurated tissues of the strained part, the needle is withdrawn and the puncture closed with collodion. Next day the insufflated region should be gently kneaded to drive the air, which tends to spread excentrically into the meshes of the inflamed tissues. Massage is repeated morning and evening at the most distended parts, and finally the leg is douched with cold water. By this method, Joly states that the effects of peritendinitis are rapidly and radically reduced, and that the indurated centre of tendinitis is quickly isolated and often reduced as well. In fifteen days, in certain cases, the tendon has become perfectly cool, clean, insensitive, and resistant to the effects of work. Insufflation is useless for old-standing extensive induration of tendons, but for cases passing into the chronic state repeated injections followed by massage or counter-irritation may bring about functional recovery.

Chronic strain cannot be cured, though usually an attempt is made by further treatment to render the horse workable. With owners and veterinarians cauterization is the favourite remedy, but perhaps it is less popular than formerly, and it cannot be described as a specific for strained tendons. Superficial firing, in lines or by budding, when useful at all is most successful in simple cases, but of the many strained tendons fired in this manner the advantage to the horse has seldom been very marked. Deep line-firing probably is more beneficial than any other mode of cauterization, but whether it acts by inducing the formation of a more extensive subcutaneous œdema or by merely exciting cutaneous inflammation with consecutive compression of the strained part, is not known. Firing in points, the needle penetrating the induration, has a very limited application. Pyro-puncturing may be justified on the assumption that it reproduces deep-seated inflammation and establishes a further process of repair and consolidation of the distension. But unfortunately for the success of this method, it promotes the formation of adhesions between the skin and subjacent tissues and shortening of the tendon, disadvantages that detract much from its value as a remedy for strain. Besides, deep puncture-firing is dangerous where a synovial sheath exists, and an operation that may produce open synovitis should not be undertaken without due consideration. For perforatus strain at the middle of the cannon and strain of the suspensory, puncture-firing is useful enough.

Neurectomy.—When other treatment fails, neurectomy should be tried. Frequently it is too long delayed. It enables a horse that has become useless from chronic strain to work moderately for a year or longer according to the case. But like other treatment, neurectomy has its limits of usefulness. It does not arrest the tendinitis, which after operation may become aggravated. It does not prevent, while it may hasten, shortening of the tendon, and in some cases it does not entirely remove the lameness, which is said to be mechanical. It is not advisable for saddle horses; and for heavy draught horses, while permitting profitable disposal, it does not give satisfaction. Notwithstanding these objections neurectomy should not be neglected in suitable cases of chronic strain.

Complete subcutaneous rupture of perforans, perforatus, or suspensory may be simple, involving one cord; double; or multiple when both flexors and suspensory are ruptured; spontaneous or primary, when affecting a clean and apparently healthy tendon or suspensory; acquired or secondary, when following neurectomy, tendinitis, synovitis, contusion, gathered nail or fracture.

The position varies; perforans, at the pastern, near its insertion, or at the sesamoids. Subcarpal ligament (?); perforatus, a few inches below the knee, at the fetlock, or towards its insertion. Suspensory, one or both branches near sesamoids. Upward splitting of body of ligament sometimes included with rupture.

Complications.—Fracture (sesamoids, navicular, suffraginis); synovitis, carpal sheath (perforatus and (?) subcarpal), sesamoid sheath (perforans, perforatus, suspensory); and navicular bursa (perforans); rupture of fetlock-joint capsule, extravasation.

Causes.—Sudden violent hyperextension exceeding the limit of resistance of tendon or suspensory; prolonged galloping, with muscular fatigue; carrying too much weight; violent struggling when cast; excitement and pressure during service (both fore flexors in mare); jumping in hunters and chasers, fore leg (flexor or suspensory), hind leg (suspensory); synovitis of sesamoid sheath (perforans); tendinitis; neurectomy (perforans); gathered nail (perforans), navicular disease, etc.

Symptoms.—These are very variable. In spontaneous rupture, sudden lameness or loss of power, horse unable to go on, limb advanced or held up, acute pain, horse very restless, sometimes kicking violently, and in kicking may luxate a hoof or more than one; rapid engorgement extending above and below the seat of rupture. Secondary rupture may be preceded by swelling of the pastern or leg, or it may take place without premonitory sign. In the stable the horse may be found with the fetlock lowered or the toe turned up, showing very little uneasiness. At exercise the horse may stumble or fall at the moment of rupture, when lameness and the deformity of the fetlock attract attention. If examined immediately after the accident, the ends of the rupture can be felt; but later, owing to swelling, diagnosis may be doubtful. When the leg is under weight, in perforans rupture the fetlock sinks and the toe turns up; in perforatus rupture the fetlock is knuckled or unaltered; and in suspensory rupture the fetlock descends and the foot rests flat on the ground. In double flexor rupture (suspensory intact) the fetlock descends and the toe turns up; and when the three cords are ruptured (complete breakdown) the fetlock and pastern rest on the ground. In rupture following tendinitis with peritendinous adhesions, the fetlock at first may sink very little or not at all, but later it descends as the adhesions become more and more stretched or lacerated. Occasionally after a severe gallop or jumping trial a fore fetlock sinks and swells posteriorly as if caused by rupture of tendon or ligament. On post-mortem examination both flexors and suspensory are found intact and the only discoverable lesion is a thickened aponeurosis. What is the explanation? Is the sinking of the fetlock due to elongation of the flexor *muscles,* or to rupture of the aponeurosis which supports the fetlock?

Prognosis.—The discussion of the prognosis of complete rupture, like that of partial rupture, to be useful, requires the presence of the patient. Generally, however, the prognosis is favourable in single, uncomplicated primary rupture of suspensory or perforatus, and less favourable but not hopeless in bilateral rupture of either cord. It is exceedingly doubtful in perforans rupture, and in cases following neurectomy or gathered nail slaughter is imperative. Rupture complicated by sesamoid or other fracture, while not always incurable, is usually sufficiently serious to suggest slaughter. Sometimes the value, sentimental or exhibition, or the breeding of the animal, if entire or a mare, prevents immediate slaughter of an apparently hopeless case, which eventually makes a useful recovery. Uncomplicated cases of single or double spontaneous rupture should not be too hastily condemned so long as the owner is willing to risk the cost of prolonged keep and treatment.

Treatment.—Rest need not be emphasized, but the length of rest required should be made clear to the owner; if the case is promising and the horse is to resume fast work he should have a year. Less may be sufficient, but more may be advantageous. A long rest furnishes the best means of ensuring success or of escaping failure in the treatment of injured tendons. In most cases slings are useful, if only for a week or two, and when the fetlock is much lowered a surgical shoe should be employed. Anodyne, refrigerant and astringent lotions or compresses to diminish the pain and swelling, then plaster or starch bandages to assist in supporting the fetlock, and after an interval, bandages having been discontinued, the leg may be blistered or fired. J. M.

Knuckling at the Fetlock.— This condition may occur at any age and is usually the result of disorders existing in other parts of the limb. Occasionally foals are born with well-marked knuckling at the fetlock-joint. This occurs more often among thoroughbreds.

Causes.—In foals the actual cause is a matter of dispute. Probably congenital contraction of the flexor tendons is often responsible, or adhesions of the tendon and overlying tissues may occur as the result of the fetlock being maintained in a position of flexion whilst in the uterus.

Some have suggested a lack of proportion between the framework and the tendinous portions of the limb; in other words, excessive length of the metacarpus or metatarsus without proportionate elongation of the flexor tendons. Myositis of the flexors has also been blamed.

In older horses contraction of the flexor tendons, subcarpal ligament or suspensory ligament may be the cause, and in the majority of cases of knuckling one of these will be found responsible.

Ringbone and chronic foot lameness may also produce an upright or knuckled condition of the fetlock, probably because the position affords the animal some relief from pain. Occasionally bony growths at the back of the pastern mechanically shorten the tendons.

Overgrown heels and upright feet will give rise to moderate knuckling, which becomes chronic through shortening of the relaxed flexor tendons. The same result may follow lameness in any portion of the limb associated with prolonged flexion of the fetlock, notably long-standing foot lameness, radial paralysis, and lameness arising from fracture of the deltoid tubercle of the humerus, which is frequently followed by contraction of the tendons. These, however, may again become normal with work or exercise.

Sesamoiditis and distension of the superior sesamoid sheath and hydrarthrosis of large size may be responsible.

Symptoms.—Three degrees of knuckling are usually recognized.

(1) When the foot, coronet, and fetlock are "upright"—that is to say, vertically placed or in a line at right angles to the ground.

(2) When the fetlock joint forms an angle open at the back of the joint.

(3) When the front of the fetlock lies beyond a vertical line drawn at right angles to the ground from the toe of the foot.

The degree of knuckling may vary according to the tissues involved. Hence contraction of the perforans tendon may produce marked volar flexion of the whole of the limb from the fetlock downwards, so that the heel of the foot is raised from the ground and the horse stands and walks upon the toe. Contraction of the subcarpal ligament, the result of repeated strain, often involves a portion of the perforans tendon and produces knuckling, but frequently thickening of the ligament alone exerts sufficient pull upon the tendon to cause a marked straightening of the phalangeal articulations.

Contractions of the perforatus and suspensory ligament produce knuckling of the first and second degrees, the foot being firmly planted upon the ground, the animal being able to bear his weight on heel and toe alike.

The condition *per se* is not a painful one unless either of the metacarpal or plantar nerves be involved in the fibrous thickening, which during contraction may exert pressure upon the sensitive fibres. This is not a common complication, and is more likely to occur after line-firing or blistering, which produces subcutaneous inflammation, which may, and probably always does, extend to the deeper tissues. Subsequent contraction of the organised inflammatory products may then cause pressure changes in the nerve.

Knuckling may, however, be attended by pain in the limb when it arises from acute strain of the tendons with a great deal of thickening in the early stages.

The degree of lameness in chronic cases varies according to whether the knuckling be excessive or slight. In the latter case (upright joints) there may be little interference with action, beyond a tendency to stumble. When more pronounced, the limb bears very little weight whilst the animal is at rest, but during movement the foot is placed upon the ground with confidence, excepting in perforans contraction, when the animal "goes on the toe," being in many cases unable to lower the heel sufficiently to reach the ground. There is, however, a peculiar hesitation displayed in the gait, with a tendency to stumble. The horse quickly tires, and when knuckled in both fetlocks may be useless for work and only able to remain standing for a limited period. The lameness usually arises from the condition of the tendons, which are unable to play their part in sustaining weight and maintaining balance. Possibly the altered relations of the joint surfaces contribute to the uncertain, insecure gait, but as the articular surfaces themselves show no lesions, the lameness must be considered as mechanical excepting when acute tendinitis or ostitis is coexistent.

Prognosis.—This depends upon the age of the animal, the extent of the knuckling, and structures involved.

Foals born with "overshot" fetlocks usually recover in the course of a few weeks or months. In the majority of cases the shorter period suffices, there being no changes in the tendons.

Sometimes knuckling of the third degree is seen. The foal may then walk on the front of the fetlock and produce serious injuries, which may necessitate slaughter.

Recovery usually depends upon whether the animal can stand upon the foot itself. In cases when this is possible, time alone usually brings about cure.

In two-year-olds, especially among racing stock, knuckling may occur in colts or fillies which were sound at birth, and prognosis is then very uncertain. Some cases recover completely, but these are rare; others partially recover but are rendered useless for racing, whilst some develop into permanent cripples. The condition is frequently bilateral.

Knuckling, occurring as the result of strained and contracted tendons in older horses, is always a serious condition and when well marked can only be benefited by operation, and even then the results are not always satisfactory. In cart horses the prognosis is more favourable than in lighter animals. Even a moderate degree of knuckling in a hack or hunter renders it unsafe.

Treatment.—This must vary somewhat according to the cause of the knuckling. When it has occurred as the result of resting the limb or prolonged flexion of the phalanges, as may happen in cases of chronic foot lameness, radial paralysis, etc., elongation of the tendons will usually occur after the primary lameness has ceased and when the limb has again been brought into full use. The process of recovery may be aided and hastened by the use of a suitable shoe. In knuckling of the first and second degrees a thick toe with tapering heels will be sufficient, but in extreme cases it may be necessary to weld a toe-piece or prong on to the shoe to prevent the toe of the foot from being carried behind the line of support. By this means the animal is forced to place weight upon the foot and so to exert a pull upon the tendons.

Whilst in the majority of cases of knuckling due to inaction of the flexor tendons, recovery occurs sooner or later, the same cannot be said of knuckling arising as the result of inflammatory changes and contraction. Such cases do not readily respond to treatment, and the best we can do in most instances is to bring about some amelioration of the symptoms.

Knuckling of the first and second degrees may sometimes be improved by line-firing and blistering, and at the same time surgical shoes such as those described above may be of assistance. Care must be exercised in shoeing so that fresh strain and a recurrence of inflammatory symptoms may not result. Attempts to secure stretching of contracted tendons should only be made when the condition is of some standing and not associated with pain.

In any case a prolonged run at pasture is a necessary accompaniment of any attempt at treatment.

Tenotomy, much practised in the past, has now to some extent been discarded, mainly on account of the troublesome complications which may ensue and because in many cases the last state was worse than the first. In horses which are worth treatment, will repay prolonged idleness and cannot be otherwise rendered useful, tenotomy, properly performed, will in many cases effect a cure or at least restore the animal's usefulness, especially for slow draught work.

It is important to recognize the exact seat of the contraction. This is often difficult or impossible, owing to the amount of fibrous thickening present. The position of the foot and fetlock-joint will afford some additional evidence, but as in many cases there is fibrous adhesion between the two tendons and often between the edges of the check ligament and the perforatus as well, which thus form a tube through which the perforans tendon glides, it may be necessary to sever both tendons. When these adhesions between the tendons cannot be broken down by means of the spatula the operation usually ends in failure. In any case the perforans should first be divided and forced extension applied to the limb with the object of breaking down any loose adhesions between the tendon and aponeurosis, which may prevent extension of the phalanges. Should this be still impossible nothing remains but section of the perforatus tendon also. Knuckling of the first degree may still remain from thickening and shortening of the suspensory ligament.

When the perforatus has been divided, excessive dorsal flexion may occur and prevent the horse from using the limb. It is, however, essential that a certain degree of dorsal flexion should be present, this indicating complete division and separation of the tendons.

The next step in treatment, and the one which decides whether the operation shall be a failure or success, is the application of a surgical shoe. If dorsal flexion be too great the heel may be raised somewhat; if insufficient, the toe must be thickened and the heels lowered. As the cicatricial tissue commences to contract, the heels must be kept sufficiently low to maintain a degree of dorsal flexion considerably in excess of the normal position, otherwise the termination will be unsatisfactory and knuckling will again ensue. Exercise is essential during the early stages of treatment excepting after section of both tendons simultaneously, when it may be found necessary to place the horse in slings and hold the limb in the position of normal phalangeal extension, by means of a splint, for the first week. After this, exercise in a loose-box for another week may be necessary before turning the animal away to pasture.

Foals usually recover with exercise alone provided they can stand, but two-year-olds are very resistant to treatment. In both cases forced extension should be practised daily when the patient will permit of it, the leg being held up and backwards by an assistant whilst the operator forcibly attempts to extend the fetlock by downward pressure on the heel of the foot. Hand-rubbing the tendons may also assist.

Various forms of extension apparatus are on the market, and Friebel's type is recommended. Two-year-olds should be shod with thin heels, thick toes, and a toe-prong when it is thought necessary.

Distension of the bursæ of the extensor pedis and extensor suffraginis tendons may occur at the front of the fetlock in a fore limb. In the hind limb the bursa of the extensor pedis tendon may be similarly affected. The cause is usually external violence, sometimes brought about by striking the part against the manger supports, or against a wall or door, or through sudden knuckling. Falls may also cause bruising of the front of the fetlock, and, when the skin is broken, dangerous complications occasionally ensue, as the bursa of the extensor pedis is in some cases continuous with the synovial capsule of the joint.

Horses which sleep standing and which do not lie down, frequently injure this part from knuckling forward upon the fetlocks by night.

Prevention consists in removing any object against which the joint may be accidentally struck, and causing the horse to wear a leather boot or a Yorkshire boot for protection during the night, or altogether whilst in the stable.

In the early stages cold irrigation should be followed by the application of lead and alum lotion, or "white" lotion poured over a pad of cotton-wool, which should be retained in position by means of a bandage. Subsequently blistering may help to reduce the enlargement.

Surgical interference should be avoided, owing to the risk of communication between the bursæ and the joint capsule.

Synovial Distensions in the Fetlock Region. "Windgalls." Inflammation and Distension of the Sesamoid Sheath of the Flexor Tendons.—The great sesamoid sheath extends from the level of the "buttons" to the middle of the os coronæ, where it is separated from the navicular bursa by an attachment of the perforans. It lines the aponeurosis and sesamoid pulley and is reflected on the flexor tendons, being modified at the sesamoids by the absence of endothelium on the anterior surface of the perforans. There is no synovial covering on a portion of the posterior surface of the perforatus, which is united to the aponeurosis of the fetlock.

The navicular bursa or sheath extends from the middle of the os coronæ to below the navicular bone; it forms a short synovial sac between the perforans and the navicular bone and its interosseous ligament.

Distension of the sesamoid sheath may arise from inflammatory changes or may be merely a dropsical condition of the synovial cavity. The so-called "windgalls" are the result of an increased secretion of synovia which causes a bulging of the sheath upon either side of the flexor tendons. Windgalls may also be due to similar distension of the synovial cavity of the fetlock-joint. They then appear between the metacarpus and suspensory ligament. This type is often spoken of as "articular windgall," whilst distension of the sesamoid sheath is referred to as "tendinous windgall." The latter condition is more often seen in the hind limbs than in the fore, and although it may appear in young horses it is more frequently seen in older animals which have been worked hard. It is very common in cart horses, but occurs almost as frequently in lighter horses which are accustomed to starting and pulling comparatively heavy loads, and especially in those used for trotting. Light vanners and cab horses are particularly susceptible; carriage horses and hacks are less frequently affected.

Whilst articular windgall is usually non-inflammatory and often the result of weak conformation, tendinous windgall, although it *may* be congenital, is more frequently produced by persistent irritation of the sesamoid sheath, associated with frequent slight or severe straining of the flexor tendons or suspensory ligament.

It is usual for the tendons, at any rate in the late stages of the condition, to become considerably thickened and callous. The synovial sheath also becomes involved and its contents become fibrinous, the whole forming a hard, incompressible mass through which one can distinguish the component anatomical parts only with great difficulty.

The condition may also be associated with sesamoiditis, with changes between the gliding surfaces at the back of the bones and the flexor tendons, and in advanced cases there may be adhesion between these parts.

When inflammation of the sesamoid sheath occurs in hunters it is frequently the sequel to rupture or severe strain of the suspensory ligament or of one of its branches.

Rheumatic bursitis may also affect the sesamoid sheath.

Symptoms.—Articular windgalls being the result of an excessive secretion of synovia into the fetlock-joint, have certain fixed anatomical relations. The synovial membrane is bounded in front by the capsular ligament and at the side by the lateral ligaments. Distension of the sac can therefore only make its appearance on the posterior aspect of the joint between the metacarpus or metatarsus and the suspensory ligament, *or* below the sesamoids between the suffraginis and the middle inferior sesamoid ligament.

They usually appear as small, firm but elastic swellings between the branches of the suspensory ligament and the metatarsus or metacarpus.

In their early stages the swellings are firm and tense whilst weight is placed upon the foot, but are easily compressible or may entirely disappear when the foot is lifted from the ground.

When the pressure of synovia within the articulation is excessive, the lower synovial pockets between the sesamoid ligaments also become distended.

Whilst most windgalls are capable of compression, yet with age and hard work they may become hard and indurated through thickening of their walls and the formation of masses of fibrin within their cavities. Knuckling may thus be brought about.

Lameness is seldom present excepting when the distension is sufficient to produce mechanical interference with the function of the joint.

Distensions of the sesamoid sheath (tendinous windgall) first appear as elongated compressible swellings running from the sesamoid bones as high up as the buttons of the splint bones, parallel with the edges of the perforans tendon.

With increase in the pressure within the sheath, distensions may appear below the sesamoids in the form of small oval swellings reaching to the os coronæ and protruding at those points where the enveloping fascia is less dense.

Distensions of the sesamoid sheath may be compressible during their early stages and when they occur in young horses which have done but little or no work, but when associated with lameness they usually take the form of constant fixed swellings which cannot be caused to disappear at any position of the limb. The tendency is for the swelling to increase in size and to become, under the influence of advancing age and work, complicated by inflammatory changes in the tendons and suspensory ligament with resulting thickening of the walls of the sesamoid sheath. The swelling eventually becomes so tense and indurated that the anatomical relations of the parts can only be made out with difficulty.

Lameness, though absent in most cases of pure tendinous windgall, is almost constant in tenovaginitis. The horse appears to take a shorter stride with the lame leg and throws his weight upon the toe. In severe cases the heel of the shoe is never brought to the ground. Lameness diminishes with rest but reappears with work. It is most marked whilst travelling uphill.

Treatment.—Windgalls, whether articular or tendinous, may be benefited, at least temporarily, by bandaging. Articular windgalls seldom call for treatment, being usually merely eyesores. When, however, they are of sufficient size to produce mechanical interference with the action of the fetlock joint or when they become indurated, line-firing and blistering give the best results. Cases have been reported of successful results obtained by removing an elliptical piece of skin from over the swelling and suturing. Could asepsis be guaranteed both at the time of and subsequent to the operation, this would appear an ideal method of removing the enlargement, but unfortunately in everyday veterinary practice conditions are seldom favourable, and the results may be far from satisfactory. Aspiration and injection of iodine solution followed by its withdrawal, with subsequent bandaging, may be tried but is often unsuccessful, as the sac usually rapidly refills. The same remarks apply to the treatment of tendinous windgall.

When lameness occurs there is usually tendinitis or sesamoiditis present as a complication.

In mild cases relief from lameness may be obtained by shoeing with heels, though this predisposes to shortening of the tendon with chronic lameness as a sequel.

Nothing has yet been discovered which gives better results than the actual cautery. Line-firing is best, and should be followed by the application of a mixed cantharides and biniodide of mercury blister. A long rest is required, and the animal may be with advantage turned out in a flat field. Unfortunately cases which make an apparent improvement under treatment often again become lame when put to work.

Inflammation of the Bursa of the Middle Gluteal Muscle.—The middle gluteus has three insertions, one into the summit of the great trochanter of the femur, another into the back of the trochanteric ridge, and a third which plays over the convexity of the great trochanter, being separated from it by a synovial bursa, and is inserted into the trochanteric crest. Strain of this latter tendon, or external violence, may produce distension of and inflammatory changes in the underlying bursa. Falling, struggling on the ground, and blows sustained in narrow doorways or gateways may be the cause of the injury.

Symptoms.—The lameness usually appears suddenly and in most respects resembles hip-joint lameness. The limb is abducted and the horse is inclined to travel " on the toe." Whilst trotting, the limb is advanced with an upward jerk of the quarter, with as little movement of the hip as possible. There is usually swelling of the trochanteric region.

Lameness may persist for some considerable time, or it may subside in a few days upon disappearance of the swelling.

Treatment.—Hot fomentations, followed by gentle massage and the application of a mild liniment such as Lin. camph. co., preferably with the addition of belladonna, may bring about recovery in mild cases.

Some practitioners recommend cold irrigation, preferably applied with some force, as with a hose-pipe from a short distance, others advocate alternate hot and cold packs.

Chronic cases may be blistered. Should this fail to bring about recovery, setons may be tried or the part may be fired in lines or points.

A high-heeled shoe frequently gives relief in long-standing cases. Rest is at all times the main factor in securing a favourable termination.

Bursitis Præpatellaris — Capped Stifle.—The prepatellar bursa sometimes becomes distended as the result of bruising. It then produces an enlargement, sometimes of the size of a coconut, on the front of the stifle. The swelling is subcutaneous and its limits can be defined upon palpation, whereas in distension of the joint capsule the swelling lies deeper and cannot be displaced, nor is it so sharply defined. Lameness is absent unless the enlargement is sufficient to interfere with movement. Inflammatory symptoms are rare.

Treatment.—In the early stages cold fomentations, followed by lead and alum lotion, may considerably reduce the size of the swelling. Usually a small enlargement remains, and this may sometimes be caused to disappear by blistering.

Should this fail, aspiration and injection of a 1 per cent solution of hydrarg. perchlorid. may be useful. The injection should be withdrawn after a few minutes. The operation may need repeating several times.

Surgical interference has occasionally been recommended. The bursa may be opened throughout its length and plugged with some agent which will destroy its lining. A 10 per cent solution of nitrate of silver on cotton-wool may effect this, but whatever agent be employed, the dressing should be carried out by the veterinary surgeon himself. A mixture of acid. carbol. liq. 1 part and glycerine 3 parts is a useful application for the purpose of arresting secretion.

Capped Hock.—The term "capped hock" denotes a swelling on the point of the hock. The nature of the condition varies according to the structures involved, and before proceeding farther it is well to consider the anatomical relations of the parts.

Underlying the skin is the bursa calcanea, a comparatively small mucous bursa resembling that occurring at the point of the elbow. Below this is the perforatus tendon, which forms a cap covering the tuber calcis, to which it gives off a slip of insertion on either side before proceeding farther down the leg. Completely covered by this fibrous cap is the insertion of the gastrocnemius tendon.

Lying between the gastrocnemius and perforatus tendon and covering a portion of the summit of the os calcis is the sheath of the perforatus tendon. This extends for from three to four inches above the point of the hock and for two inches below it, but for a short distance above the summit of the calcis it is supported by a strong fibrous band on either side, hence when this sheath is distended two distinct enlargements are visible, separated by the above-mentioned band. The connection between the two is, however, quite evident upon palpation.

Capped hock may therefore be a superficial condition involving the skin and subcutaneous bursa or it may be a bursitis of the perforatus sheath. From extensive injury or the result of infection the lesions may involve both the cap of the perforatus tendon and the tuber calcis itself.

Superficial capped hock is by far the more common condition and may be regarded as a hygroma resulting from bruising. The causes are usually self-inflicted injuries from kicking whilst in harness or in the stable, or occasionally from lying upon hard, stony floors. The position in which the animal lies sometimes has some influence in inducing bruising. Horses on rail are very liable to injure the points of the hocks, unless efficiently protected by leather caps or by padding the woodwork immediately behind them.

The symptoms of hygroma are swelling and, in the early stages, lameness, though this is by no means constant. The contents are at first fluid, but when the condition has become chronic there is usually considerable thickening of the skin with but a small amount of fibrinous fluid present.

In synovial capped hock involving the sheath of the perforatus tendon there is usually severe lameness, especially if infection occurs, and in addition to enlargement of the superficial bursa the whole of the cap of the hock is swollen and cellulitis may extend for some distance above and below the tarsus. Well-marked distension of the perforatus sheath may be visible above and below the point of the hock on either side of the tendon. Necrosis of the tuber calcis may occur in rare instances: enlargement is not uncommon.

Prognosis.—Superficial capped hock, though seldom a serious condition or liable to interfere to any extent with the usefulness of the animal, is nevertheless very difficult to get rid of and is seldom completely curable.

Some animals have a habit of striking the hocks and so constantly aggravate the condition.

Synovial capped hock is at all times a grave condition and requires a very guarded prognosis.

Treatment.—In all cases of capped hock cold fomentations should be employed during the inflammatory stage. A mild astringent lotion such as of lead and alum may be used to supplement this treatment.

As soon as the inflammation has subsided a biniodide of mercury blister may be applied, or the part may be rubbed with oleate of mercury, or painted daily with iodine or a lotion containing hydrarg. biniodid. grs. v., pot. iodid. grs. x. to the ounce of water.

Puncture has frequently been advocated, but it is seldom attended with marked success, as the bursa rapidly refills, and should infection occur the condition is rendered worse than before. To avoid refilling bandaging is necessary, and this is attended by so much resistance on the part of the animal as to render it impracticable.

The bursa may sometimes be ruptured subcutaneously by applying a tight bandage whilst the opposite hind limb is held up. On releasing the animal his struggles to free the hock may cause the walls of the bursa to break and the contents may be discharged into the tissues and absorbed.

Radical operation—*i.e.* excision of the walls of the bursa after removing an elliptical piece of skin—is not to be recommended in everyday practice. In old cases with much fibrous thickening a charge may be applied to the cap of the hock and left in position as long as it will remain and then renewed. After several months a very considerable reduction may be evident.

Thiosinamine solution in one of the proprietary forms may help to remove fibrous thickening.

Prophylaxis is equally important, and it is essential that the cause be discovered and removed. Usually some projection in the stable is responsible.

Synovial capped elbow must be treated on similar lines during the inflammatory stages, but when distensions remain which interfere with movement of the limb the best results will be obtained by line-firing and blistering.

Luxation of the Perforatus Tendon.—The cap of the perforatus tendon is retained in position on the point of the os calcis by two lateral slips inserted into the bone. Occasionally, when a horse which has been confined to the stable is taken out for exercise and lashes out violently, one or rarely both of these lateral attachments may be ruptured, thus allowing the perforatus tendon to become displaced from its normal position and to slip to one side of the os calcis.

Similar injury may result from falls, especially whilst jumping, or from external injury, as from a kick by another horse.

The luxation may be either internal or external according to which insertion is ruptured. Internal displacement is the more common owing to the direction in which the tendon passes over the hock, *i.e.* from within outwards. In internal displacement the tendon remains fixed about half-way down the astragalus, or it may slip down its whole length. In external displacement it becomes arrested on the ridge of the bone. The latter is the more favourable condition.

Symptoms.—In internal displacement the leg is raised but very slightly during progression. In both cases flexion of the hock is interfered with and a peculiar backward lifting movement of the leg may be noticed. The perforatus tendon can be seen to roll on and off its normal seat during movement of the limb.

Lameness is usually mainly mechanical unless the condition be complicated by injury to the tendon, bone, or tendon sheath.

Prognosis.—Absolute recovery is doubtful in all cases as the limb cannot usually, in large animals, be kept sufficiently still for reunion of the torn slip to occur.

In outward luxation the tendon may become accommodated to its new position and the animal may again become workable. Harness horses may even be able to do fast work without apparent disability.

Inward luxation requires surgical treatment. The animal is cast and anæsthetized. A tape suture is then inserted through the perforatus tendon and through the tendo Achillis, whilst a second is inserted through the perforatus and the calcaneo-metatarsal ligament. The ends should be left hanging and tied after the horse is on his feet and in slings. Tape is preferable to wire as it causes more irritation, and the subsequent swelling and formation of connective tissue assists in maintaining the tendon in position.

Silver-wire sutures passed through the os calcis may be successful in some cases.

Distensions of Synovial Sheaths in the Tarsal Region—Distension of the Sheath of the Perforans Tendon—Thoroughpin.—Thoroughpin is a distension of the sheath of the perforans tendon as it passes through the tarsal arch.

"Articular thoroughpin" is a term sometimes used to describe bulging of the capsule of the true hock-joint occurring at the hollow of the hock, that is to say, at the angle formed by the lower end of the tibia and the os calcis. At the same time, another distension may be present on the outer aspect of the joint in a similar position. Articular thoroughpin is usually associated with bog-spavin. True tendinous thoroughpin is characterized by the presence of a synovial enlargement on either side of the hock well in front of the tendo Achillis and on a level with the tuber calcis in the case of a thoroughpin of moderate size, or covering a large part of the inner surface of the hock in one of large size.

Stallions are very frequently affected with thoroughpin, but the condition is to be met with in all classes of horse, especially cart-horses which have to start heavy loads. It is also prevalent in the upright hock with a short and poorly developed os calcis. This conformation is probably hereditary and may account for the fact that thoroughpin is often transmitted.

A thoroughpin is not always constant in size; it may appear suddenly and disappear without treatment, or it may vary in size according to the amount of work performed and climatic conditions. Thoroughpins are usually smaller in winter than in summer; with rest they decrease in size, but they rapidly assume their former proportions upon resuming work.

Lameness is very rarely observed excepting in the early stages of thoroughpin arising from sprain, as in starting a heavy load, jumping, rearing, or falling back upon the haunches.

Treatment is seldom required except in animals used for exhibition purposes. Firing is probably the best treatment for thoroughpin associated with lameness, but in ordinary chronic cases it only substitutes one blemish for another. In exhibition animals Dean's operation—*i.e.* withdrawal of the contents by aspiration and injection of an antiseptic—may effect a cure. 1 per cent iodine solution with pot. iodid. or ½ per cent alcoholic solution of hydrarg. perchlorid. with the addition of decolorized iodine may be employed, the liquid being subsequently withdrawn and the parts surrounded by a pressure bandage.

Simple blistering does good in some cases.

Trusses are not so commonly employed now as at one time. They are hard to keep in position, and better results are obtained by using an elastic stocking padded over the position of the distension. In either case the enlargement usually reappears when the use of the appliance is discontinued.

In working horses suffering from large thoroughpins some benefit will be derived from shoeing with calkins.

Distension of the Tendon Sheath of the Peroneus.—The peroneus tendon in its passage over the outer aspect of the hock is provided with a synovial sheath. Either from traumatic injury, as striking against a bale, or from strain, this may become distended and then appear as a swelling at the upper end of the cannon bone. It varies in size from that of a walnut to that of a man's fist.

Lameness is exceptional.

Treatment is seldom required, but when demanded aspiration and subsequent bandaging may give good results, particularly as the part is suitable for the application of pressure-dressings. Line-firing and blistering may also partly reduce the swelling.

Distension of the sheath of the extensor pedis is uncommon.

Distension of the sheath of the flexor pedis perforatus has been mentioned under the heading "Capped Hock."

The bursa lies between the perforatus and gastrocnemius tendons and between the former and the tuber calcis. The distension extends for four inches above the point of the hock, and a second distension usually appears about two inches below this, the two being continuous but divided into two parts by a transverse fibrous band.

The enlargement appears on both sides of the tendo Achillis and results from strain or overwork, whilst faulty conformation plays a part. Lameness is seldom present excepting when the condition results from traumatic injury, as when associated with capped hock.

Firing in lines and the application of a blister will usually be sufficient when treatment is required.

R. H. S.

SHIVERING

"Shivering" is a nervous affection characterized by spasmodic movements of certain groups of muscles, notably those of the hind limbs and the tail, although in certain cases those of the fore limbs or even of the face or trunk may be involved.

The cause is believed to be a slowly progressive sclerosis of the spinal cord with increase of connective tissue and diminution of nervous elements, together with lack of vascularity. Heredity in all probability plays some part in the production of the disease.

In some instances "shivering" appears to arise as a sequel to some antecedent constitutional disease, as strangles, pneumonia, or influenza, in which toxins may be produced, which may in certain cases affect the spinal cord, though sometimes "shivering" does not make its appearance until some years after the primary disease has disappeared. The connection between the two conditions is often somewhat vague and open to doubt.

The disease occurs in all classes of horse, of all ages, but is probably least common among ponies, particularly among ponies bred under natural conditions upon moorland. It would thus appear to be induced by domestication.

The symptoms of shivering are quite characteristic when marked, although they may be very hard to detect or even unnoticeable when only very slight. As a rule, nothing unusual can be detected whilst the animal is standing still, as when feeding in the stable. In a well-marked case the symptoms are exhibited immediately the animal is moved, or perhaps only during the first few steps, when he is turned over in the stall, and particularly when he is forced to back, a movement accomplished with difficulty. Some horses only show symptoms after foot injury, as after being "pricked" during shoeing, or when dermatitis exists below the hock (grease, cracked heels, etc.), or when symbiotes are present. Possibly the latter instances are not true examples of the disease, but nevertheless symptoms identical with "shivering" are manifested under these circumstances in certain animals.

When the spasms are excited by any of these stimuli, the hind foot is suddenly jerked from the ground and the limb is held suspended in mid-air in a position of abduction, quivering violently, whilst in more severe cases the intermittent spasmodic movements may be so pronounced that the horse is only able to retain his balance by performing hopping movements with the other limb. At the same time the tail is elevated and trembles rapidly, whilst in occasional instances other groups of muscles become involved, as those of the face, ears, and even those of the trunk. The symptoms become very aggravated if any injury to the lower portion of the limb should occur. Attacks of colic, catarrh, etc., also appear to render the symptoms more severe, and during the course of the illness the horse may be unwilling or unable to lie down and may be incapable of again getting on his feet should he do so. Some "shiverers" always sleep standing, and accordingly may suffer from chronic contusions of the fetlocks from knuckling whilst at rest.

When a fore limb is affected the leg is first abducted and then carried forwards, quivering the whole time. Sometimes the muscles of the lips, eyelids, and ears are involved alone or in company with one of the limbs. The commissure of the lips is retracted, the eyelids flicker, and the ears quiver.

In very slight cases involving the limbs detection is often very difficult and is of considerable importance, if only as regards examination for soundness.

Backing the animal or turning him in either direction in narrow circles may be sufficient to reveal the existence of the disease, but in very mild cases more severe tests may be necessary. Lifting or hammering the hind feet, particularly whilst the horse is resting after exercise, or pricking the coronet may reveal symptoms of the disorder.

Shivering usually shows a tendency to become worse with work and to improve after a rest. Its appearance may occasionally be quite sudden, but usually it develops very slowly. Hunters may jump well one season but the next may have difficulty in lifting the hind limbs over an obstacle. Gradually the posterior extremities become stiff and the muscles undergo atrophy, so that the animal is unable to do the work required of him. He shows no inclination to lie down, or if by any chance he does assume the recumbent position, he is found down in the morning and unable to rise, though he will usually succeed in doing so if rolled over on to the opposite side. Some shiverers, however, work for years without showing any marked inability to perform their tasks.

Treatment is quite useless.

STRINGHALT AND PARAPLEGIA

Stringhalt.—The term "stringhalt" is applied to involuntary movements of the hind limbs of the horse during progression, by which the hocks are suddenly flexed with a more or less violent jerk and may also be extended or brought to the ground with more than usual force.

The spasmodic contraction is usually more marked in the case of the flexor muscles of the hock than in that of the extensors, but occasionally the opposite condition exists and the horse "hammers" the ground with his hind feet. This action may be so pronounced that considerable difficulty may be experienced in keeping the animal shod. One or both limbs may be affected, more commonly both. Stringhalt or an analogous condition is occasionally though rarely observed in the fore limbs. All classes of horse may be affected.

The etiology of stringhalt is still very obscure. At one time or another the seat of the disorder has been traced to practically every part of the horse's limb, but none of the theories propounded is very satisfactory. Possibly a number of factors contribute, or the cause may not be the same in every case. Some of the commonest causes enumerated by various observers are, briefly: spavin, contraction of fascia of thigh, of the peroneus, of the fascia below the hock, of the tensor vaginæ femoris, of the inner lateral ligament of the patella, chronic arthritis of the hip-joint, of the true hock-joint, foot trouble of various kinds, asymmetry of the skull, brain disease, brain tumours, changes in the spinal cord, hyperæmia of the sciatic nerve, changes in the extensor pedis tendon, exposure to cold, and numerous other causes (?). The mere fact that so many varying theories exist is sufficient proof that the actual cause of stringhalt is unknown. All that we can assert with confidence is that it is a nervous disorder; probably in some cases it is due to reflex contraction of groups of muscles stimulated by irritation of peripheral nerves, and possibly in others it arises, as Dollar suggests, from localized sclerosis of the spinal cord, in a similar manner to chorea.

The symptoms may appear suddenly at any age, particularly at from four to five years, especially when the horse has been rested or laid up in the stable for any length of time from any cause.

As a general rule, however, when stringhalt develops, very slight symptoms appear during the first few years of life, more especially when the animal is first put to work. The affection may then be only exhibited at intervals and may after some time disappear. As a rule, the symptoms become aggravated until they arrive at a certain stage of severity, when they become stationary and may show no inclination to become worse even with work and advancing age.

In very slight cases of stringhalt the horse exhibits nothing abnormal whilst at rest in the stable and during a journey. The symptoms may be best observed after the animal has been resting all night or has been standing for some time in one place. Upon moving off, more especially if flicked with the whip, the hocks will be jerked upwards with a peculiar "dancing" motion quite distinct from the ordinary rapid movements of a sound animal. The symptoms are exaggerated when the horse is backed or turned in short circles.

In slightly pronounced cases the jerking movements of the hocks may be quite distinct during the first half-dozen steps, after which they wear off and may not appear again until after the horse has been brought to a standstill and again moved on. Occasionally the hocks may be jerked up during a few steps every now and then, at other times the gait may be normal. In severe cases flexion of the hocks may be so marked that the front of the hind foot strikes the belly at each step, and upon being again brought to the ground the foot is placed down with a heavy "stamping" action. Nevertheless the animal's usefulness is seldom seriously interfered with excepting in a riding-horse, and apart from the fact that the action is unsightly the horse may pull well in harness and be nearly equal in strength to a sound animal.

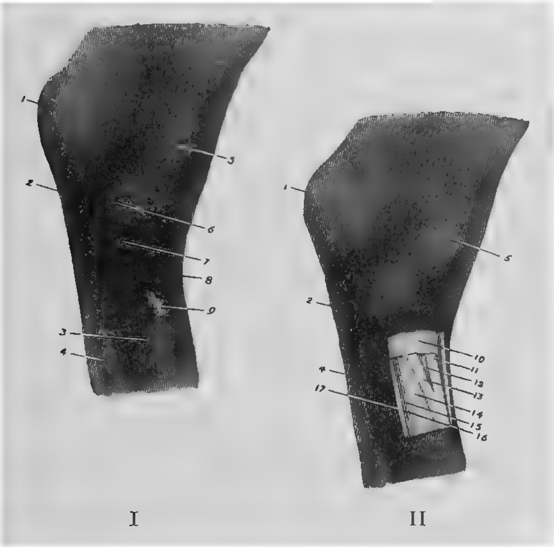

Fig. 165.—Outer side of hock and metatarsus.

I.—1, Point of hock; 2, position of flexor perforatus tendon behind os calcis; 3, groove between large and external small metatarsal bones; 4, position of flexor perforans and perforatus tendon below the hock; 5, external malleolus of tibia; 6, position of cuboid; 7, position of head of external small metatarsal bone; 8, position of extensor pedis tendon; 9, line of incision in peroneal tenotomy.

II.—10, Lowest annular band in front of hock; 11, extensor pedis tendon; 12, extensor brevis muscle; 13, peroneus tendon; 14, large metatarsal bone exposed; 15, continuation of anterior tibial nerve down the metatarsus; 16, large metatarsal artery; 17, external small metatarsal bone.

Treatment.—Without a proper understanding of the etiology treatment must be empirical and is usually futile. We have had one successful result after peroneal tenotomy in a five-year-old hunter with very pronounced stringhalt. Recovery was practically complete three months afterwards, and the horse was hunted for several seasons. Whether the good result was due to the operation is, of course, by no means certain.

Peroneal tenotomy is most conveniently performed with the patient recumbent and under anæsthesia. The limb need not be unhobbled. After preparing the skin at the seat of operation an incision is made at the point indicated in Fig. 165. A grooved director is inserted under the tendon, which is then divided by a probe-pointed bistoury passed along the groove. The wound is then closed by one or two sutures and covered by an adhesive protective.

Some operators advise cutting also the fascia which unites this tendon to the extensor pedis tendon. This operation certainly does no harm, and may therefore be tried as a remedy, but other operations advised by some practitioners, such as section of the tensor vaginæ femoris, the internal lateral ligament of the patella, and various neurectomies, should be avoided, as they are liable to do more harm than good, and as they have provided consistent failures in the past they may be discarded with wisdom.

Partial Paraplegia in Horses.—Partial or incomplete paralysis of the hind limbs is not uncommonly met with. It may appear quite suddenly or its onset may be gradual. For the purpose of description it is usual to recognize two types of paraplegia, differing in their etiology. (i.) True spinal paralysis, dependent upon lesions existing in the cord or its membranes. (ii.) False or spurious paralysis, dependent upon causes not associated with disorders of the spinal cord.

Etiology.—Owing to the difficulty of making a complete and minute examination of the whole length of the spinal cord in large animals, very few observations have been recorded regarding the actual lesions of spinal paralysis in the horse.

Fractures of the vertebræ usually result in complete paralysis, but fissures sometimes occur, with pressure upon the cord as the result of callus formation within the canal.

Concussion of the spinal cord is a very frequent cause of partial paraplegia. It may occur as the result of falls, particularly upon the hind quarters, as may happen when the hind feet slip beneath the body whilst rearing, or as a sequel to falls from high places, as banks. Galloping into immovable obstacles is also frequently followed by symptoms of spinal concussion. Sudden pulling-up after a gallop may act similarly, particularly when horses are grazed in hilly fields.

Hæmorrhage into the spinal canal may be produced by blows or by the same means that operate in producing concussion.

Lightning stroke or other powerful electric shocks may produce either partial or total paralysis according to the severity of the discharge.

Metastatic abscess formation may occur in the spinal cord as a sequel to strangles infection, whilst pyogenic infection is sometimes seen as a complication of poll-evil and fistulous withers.

Apart from new growths which may form in the bones (osteo-sarcoma) or in the cord, idiopathic inflammation of the cord and its membranes is probably more common than is generally supposed. Cases have been recorded by many experienced observers. Softening and swelling of the lumbar portion of the cord and pachymeningitis are said to be common lesions.

Certain toxins produced as the result of fermentative changes occurring in the stomach or intestines, from the ingestion of certain foodstuffs (irritant husks, undecorticated cotton-cake, excess of barley, maize, or wheat, etc.), are liable to produce partial paralysis. Grass at certain stages of growth, notably when flowering, has been blamed for producing certain symptoms with which paraplegia is frequently included. Horses working in hay-fields and allowed to partake of the freshly cut grass do indeed sometimes exhibit similar symptoms. Spurious paraplegia may also arise from very varying causes. In old horses union of several lumbar vertebræ (anchylosis) may produce an uncertain gait, particularly noticeable when backing a load, whilst similar symptoms, though usually more pronounced, occur after partial luxation of the sacrum or stretching of the sacro-iliac and occasionally the ilio-sacral ligaments. The latter condition is more often seen after difficult parturition, though in these circumstances paraplegia may result from injury to the pubic symphysis, or to the obturator or other nerve in the pelvic region.

Phlebitis occurring in the utero-ovarian veins may arise from infection and may lead to embolism in the external and internal iliac veins with resulting paralysis. This is more common in cattle.

Strongyles sometimes produce symptoms of partial or complete paraplegia, more especially in young colts and fillies affected with aneurism of the aorta.

Strain and succeeding atrophy of the psoas muscles may at times be responsible, though it is probable that this condition is not so frequently met with as was at one time supposed. Muscular rheumatism is more often the cause of a spurious type of paralysis and may be induced by extreme cold. We have observed marked symptoms of paraplegia in an aged cob left tied to a stake throughout a whole night during which several degrees of frost were registered. The symptoms subsided gradually and within a week had entirely disappeared.

Hæmoglobinuria also produces crural paralysis, which may be bilateral, and may persist for a number of months. Fractures of the pelvis, particularly of the inner angle of the ilium and those cases in which the pelvis has been crushed in a lateral direction, may produce symptoms often simulating paralysis.

Exposure to a very hot sun has produced cases of temporary paraplegia, and in our experience is particularly liable to do so in mares during œstrum. Iliac thrombosis may produce intermittent paralysis which is only exhibited after the animal has travelled a varying distance. The symptoms may occur in one or both limbs.

Symptoms.—Naturally, with such a wide etiology, considerable variation must exist in the severity and nature of the symptoms exhibited. Chronic cases of partial paraplegia associated with lesions in the spinal canal may remain more or less workable for the whole of their lives, but in cases which develop suddenly there is usually a tendency to become worse and to terminate in complete paralysis. This is particularly true when the condition occurs in mares heavy with foal.

Chronic cases may show no symptoms whilst at rest in the stable, neither may anything abnormal be detected whilst the horse is walked in a straight line, but upon turning or backing lack of co-ordination becomes evident and the animal rolls behind, and when badly affected crosses his hind legs. Well-marked cases show rolling movements whilst being led in a straight line, and frequently the foot is carried forwards farther than is usual and is set down with an uncertain movement.

Very slightly affected horses may even carry a man and gallop apparently sound until required to turn, when a sinking of the quarters results and the animal may come to the ground behind, recover himself, and go on again. The apparent cause of the symptoms in spinal cases is inaccurate "timing" of the various groups of muscles which do not act in harmonious combination.

Little disturbance of sensation can usually be detected; occasionally hyperæsthesia is present. Muscular atrophy is seldom seen in partial paraplegia.

Spurious paralysis may exhibit a variety of symptoms, according to the actual cause. Strain of the sacro-iliac ligaments more nearly resembles true paralysis, but frequently crepitation can be felt or heard, especially when the animal is pushed from side to side by pressure upon the angle of the haunch. Fractures of the pelvis can usually be detected by rectal examination, as can psoas strain in the majority of instances.

Treatment.—This must depend upon the exciting cause.

Paralysis arising from concussion of the cord often recovers spontaneously after an interval ranging from a few days to months.

Severe cases require slinging; mild cases are better at pasture in summer in a level field or during winter in a large box, with short bedding which will not catch the feet. Spinal paralysis seldom yields to treatment. Externally we may apply blisters with the idea of reducing congestion; a freshly flayed sheep-skin tied over the loins was formerly much employed, with little benefit, for the same purpose, and it has the disadvantage that it is liable to breed maggots and cause considerable trouble. Internally salicylate of soda, iodide of potash, and nux vomica may be employed. Iodide of iron combined with strychnine may also be found useful, whilst in many cases we have had satisfactory results from the employment of small doses of liq. ferri perchlor. combined with liq. strychninæ and liq. arsenicalis. Possibly apparent success is frequently attributable to incorrect diagnosis.

For chronic partial paralysis Macqueen recommends strychnine in gradually increasing dosage. He commences by giving twice daily a ball containing one grain of strychnine and continues until twelve balls have been given. He then gives twelve more balls, each containing two grains, then twelve of three grains, and so on until twelve of five grains have been given. He then recommences with a dose of two grains and continues as before.

This treatment is continued until the horse exhibits superficial twitchings or other early symptoms of strychnine poisoning. Usually whilst feeding the horse is seized quite suddenly with a convulsion ; it rears, falls, and struggles round the box lying on its side, moving the limbs as in galloping.

He then administers a drench, previously prepared and kept in readiness, composed of four ounces of roughly teased black Lurgan twist tobacco, infused with a quart of boiling water and strained. The draught is administered without difficulty during the intervals which gradually lengthen between the seizures. There is no danger to the attendant so long as he remains behind the horse's neck. In a few minutes the symptoms abate, and usually within twenty minutes the horse is again up and feeding as if nothing unusual had happened. This treatment, including the antidote, may have to be repeated several times in order to effect a cure.

Infusion of tobacco appears to be a satisfactory antidote to strychnine poisoning, and is the only one which can be relied upon to overcome the symptoms.

Spurious paralysis must be treated according to the cause. Sometimes treatment is impossible and frequently useless ; at other times rest and nature will often, as far as may be possible, effect recovery. R. H. S.

LAMENESS ARISING FROM PARALYSIS OF PERIPHERAL NERVES

Suprascapular Paralysis — Shoulder Slip. — *Causes.*—Paralysis of the suprascapular nerve is seen more often in country districts than in large towns, particularly amongst young horses used in ploughing. This has led many veterinary surgeons to regard the condition as due to strain either of the nerve or of the muscles themselves through stretching of these tissues as the animal slips in and out of the furrow or constantly walks on uneven ground. In country practice it is indeed but rarely that one meets with the condition except in young plough-horses, and it is evident that whether the theory as regards slipping is correct or otherwise the act of ploughing is in some way responsible. Possibly bruising of the nerve may result from collar pressure induced by walking on an irregular surface.

Another commonly accepted theory is that paralysis results from stretching of the suprascapular nerve by forcible backward movement of the limb, possibly at a time when no weight is being placed upon the foot. Such an accident may occur when a horse, suddenly startled, jumps forward against the manger, or when a runaway horse collides with some low or projecting object. Cavalry horses are said to be commonly affected through galloping into another animal. Forcibly drawing back the fore limb and maintaining it in that condition for some length of time, as may happen when the limb is fixed for operation on a quittor, may cause undue stretching of the nerve.

Rheumatism is regarded by some observers as a frequent cause, whilst hæmoglobinuria with muscular lesions in the region of the shoulder may produce paralysis of the suprascapular nerve, just as crural paralysis may result from the same condition affecting the hind limb.

Possibly neuritis may be of more frequent occurrence in the horse than is generally imagined and may account for many of the peripheral paralyses which are otherwise almost incapable of explanation.

Symptoms.—The two muscles supplied by the suprascapular nerve are the supraspinatus and the infraspinatus. The former is an extensor of the shoulder, whilst the latter is an abductor. The tendons of these muscles take the place of external ligaments to the joint.

Relaxation as a result of paralysis results in lack of support at the outside of the shoulder-joint, and accordingly when the foot is brought to the ground and at the moment when the greatest weight is placed upon it the point of the shoulder jerks outwards. During movement there is abduction of the limb, but whilst the animal is at rest there is a tendency to adduction owing to lack of function of the infraspinatus. The foot of the affected limb approaches more nearly to the middle line of the body than does its fellow, and this can be more readily seen when the two fore limbs are viewed from the front of the horse. Owing to loss of power in the supraspinatus there is difficulty in advancing the limb, the toe is dragged somewhat, and is usually brought forward with a circular, swinging motion.

The acute symptoms may subside very quickly and are immediately followed by rapidly advancing atrophy of the supraspinatus and infraspinatus. The spine of the scapula then appears very prominent, whilst a flat or depressed surface exists on either side. The deltoid muscle does not share in this atrophy as it derives its nerve supply from the circumflex. In some cases, in spite of the loss of function in wasted muscles, the horse may show no marked peculiarity of action, but in the majority of cases conspicuous abduction of the limb and rolling of the shoulder-joint (supporting leg lameness) persists until such time as the muscles have regained their former power of contraction.

Prognosis.—According to the degree of injury to the nerve and the extent of the resulting atrophy, recovery may occur in from six weeks to eighteen months. In some cases, however, restoration of function remains incomplete. Cases of the rheumatic type—that is to say, paralysis attributable to exposure to cold or occurring in subjects with a predisposition to develop rheumatism—usually make a speedy recovery. The same may be said of " shoulder slip " in young cart-horses which have received prompt attention when the symptoms have first manifested themselves.

Horses which have sustained violent blows on the shoulder or have become involved in collisions or accidents attended by excessive stretching of the nerve are less likely to recover.

Treatment.— During the acute stage, hot fomentation of the outer surface of the shoulder, followed by friction with stimulating liniments, tends to relieve the inflammatory swelling in cases arising from collision or injury and associated with bruising.

In the early stages rest is essential, but as soon as commencing atrophy appears exercise is beneficial. In mild cases the horse may be worked in a breast strap in place of a collar on level ground, but must not be used for ploughing or working on soft, broken ground.

Repeated blistering with a run at grass is the best treatment is most cases.

Subcutaneous injection of oil of turpentine along the course of the affected muscles has been recommended by many practitioners, as has also veratrine. One and a half grains are shaken up with seventy-five minims of water and injected subcutaneously. Pain and swelling result in both cases, and upon the dispersal of the latter after some days it is stated that visible improvement is usually evident. Intramuscular injections of turpentine are not to be recommended, as they frequently cause abscess formation and sloughing. Strychnine injections into the muscular tissue may be employed, sometimes with advantage, but due attention must be paid to asepsis.

Internally iron, arsenic, and strychnine may be of some assistance, given daily in bolus form.

Paralysis of the Musculo-spiral Nerve. Radial Paralysis.—The musculo-spiral nerve is at its origin the thickest nerve of the brachial plexus. It derives its fibres from the seventh and eighth cervical and from portions of the first two dorsal nerves. In common with the other nerves of the brachial plexus it emerges from between the upper and lower divisions of the scalenus muscle in fairly close proximity to the first rib. The dorsal roots of the plexus turn round the anterior border of the rib and leave on it a smooth impression near its upper end.

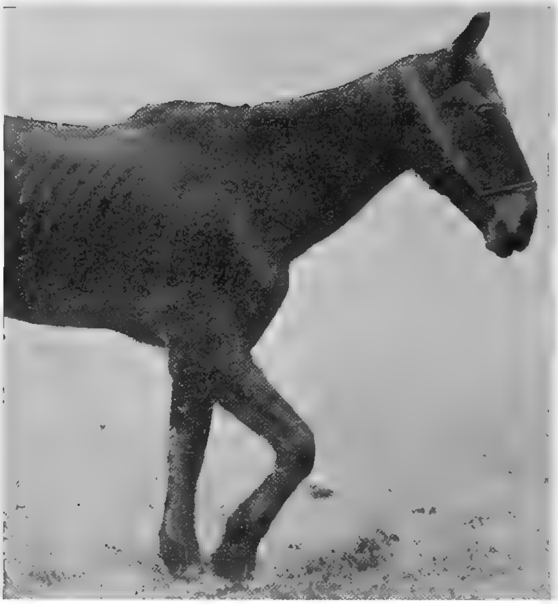

Fig. 166.—Radial paralysis.

The musculo-spiral nerve supplies the three heads of the triceps, the anconeus, scapulo-ulnaris, flexor metacarpi externus, and all the extensors of the metacarpus.

Causes.—The condition now termed radial paralysis has been recognized by veterinary surgeons for a large number of years, but was formerly attributed to strain of the muscles involved. Probably in many cases this diagnosis was a correct one, and it is quite possible to confuse the two conditions even in the light of present-day knowledge. That true cases of paralysis of the musculo-spiral do exist is certain, as has been demonstrated by autopsies which have revealed a hyperæmic condition of the nerve produced either by local pressure or by some form of neuritis.

Of late years radial paralysis has become associated in the minds of most veterinary surgeons with fracture of the first rib, and although post-mortem examination of a number of cases has revealed the fact that the two conditions may exist together, it has also shown that the identical symptoms may exist without any visible rib injury.

It is curious to note that the musculo-spiral nerve derives the majority of its fibres from the cervical roots of the brachial plexus, which do not come into contact with the first rib. Further, other nerves which are composed partially of branches from the first and second dorsal nerves, as the nerve to the latissimus dorsi, do not appear to be affected, and we have never observed paralysis of this muscle as a result of fracture of the first rib, nor is there any evidence that other veterinary surgeons have done so. It is as yet unexplained why the musculo-spiral nerve should be the only one to become involved in fracture of the first rib, especially as the amount of swelling and infiltration of the tissues might be expected to involve other nerve-trunks also.

Rogers was probably the first in this country to show that radial paralysis was often caused by this particular fracture, whilst Hunting regarded all cases of "dropped elbow" as due to first-rib fracture.

Probably many cases originate in the muscle tissue, and the changes observed in the nerve may be only secondary. The same remark may also be, in some instances, applied to other paralyses, possibly to suprascapular paralysis.

Symptoms.—In complete paralysis the animal stands with the shoulder and elbow extended and the knee and phalanges flexed. The toe of the foot is the only portion which rests on the ground. The triceps being relaxed allows of full extension of the elbow, so that the point of the elbow appears to be dropped. The appearance presented to the untrained eye suggests that the affected limb is much longer than the sound one.

When an attempt is made to move the horse, he first advances both hind legs with the object of relieving his weight from the fore limbs. He next attempts to advance the lame leg but is unable to carry it forward beyond half of the ordinary stride, where it comes to rest, the toe on the ground and the knee and fetlock flexed. Without assistance the horse, if now urged on again, will either fall or by quickly advancing the sound fore limb he may regain his balance. If, however, the foot be brought forward by the hand until the sole rests upon the ground, and if pressure be brought to bear upon the forearm just above the knee, the animal will complete his stride and will continue to advance just as long as the limb is extended for him and supported.

In partial paralysis the caput medium and extensors of the forearm are not affected. The animal can then advance the limb and place weight upon it, but at the moment of doing so the shoulder is suddenly jerked forwards as opposed to suprascapular paralysis, in which the point of the shoulder rolls outwards.

Prognosis.—The majority of cases of radial paralysis recover, though occasionally lameness may persist for as long as twelve months. The average duration is probably about three months. Partial paralysis may disappear in one or two weeks.

Treatment.—Blistering the affected muscles, hand-rubbing with liniments, or injection of turpentine, strychnine, or veratrine, may all be tried, but the sheet-anchor of treatment should be exercise in a flat field whenever weather conditions permit, or a large barn in winter, and above all, patience on the part of both owner and veterinary attendant.

Paralysis of the Brachial Plexus.—This condition results from local pressure, produced by collision with heavy bodies, injury occurring from casting or from lying for some length of time in certain positions, as with the fore and hind legs tied together for operation, subscapular hæmorrhage, extensive wounds of the axilla or front of the breast, abscess formation, exostoses occurring on the first few ribs, bullet or shell wounds, etc.

Symptoms.—Complete paralysis of all the muscles of the limbs may exist, or the condition may be confined to certain nerves, whilst others retain their function to a greater or less degree.

When the musculo-spiral nerve is uninjured, the horse can usually support his weight upon the limb whilst in the standing position.

Treatment.—As in radial paralysis.

Gluteal Paralysis.—This form of lameness is very uncommon. It is characterized by marked wasting of the gluteal muscles. The affected limb is usually adducted and at each step the foot is advanced farther than its fellow and set down with a peculiar tapping movement. The hock and phalangeal joints are usually flexed during movement of the limb.

Paralysis of the Sciatic Nerve.—*Causes.*—Bilateral paralysis is usually of cerebral or spinal origin.

Unilateral paralysis, whilst not common, is occasionally met with in horses and dogs. In both animals falls are usually responsible, though in some cases a neuroma has been discovered on the course of the nerve.

The muscles supplied by the great sciatic are the semimembranosus, quadratus femoris, biceps femoris, and semitendinosus (in part), obturator internus, pyriformis, and gemelli. The first two muscles are extensors of the hip, the biceps femoris is an extensor of the stifle, whilst the semitendinosus is a flexor of the same joint. The quadratus femoris, obturator internus, pyriformis, and gemelli are all outward rotators of the hip. The action of the rectus and vasti muscles is unimpaired.

The sciatic is also the parent trunk of the external popliteal, which divides into the musculo-cutaneous and anterior tibial nerves. The former, after giving off a branch to the peroneus, supplies the skin covering the outer surface of the metatarsus. The anterior tibial supplies the extensors of the digit and the flexor metatarsi.

Symptoms.—Paralysis of the sciatic nerve is accompanied by loss of function of the muscles of the quarter, but without impairment of that of the rectus and vasti. There is therefore inability to carry out voluntary movement of the limb, which hangs loosely. When urged on, the pull of the rectus and vasti is unopposed by the semitendinosus, and so the lower part of the limb is jerked upwards and forwards. The gastrocnemius tendon is relaxed, the fetlock and pastern are flexed, and the front of the foot rests upon the ground. As in radial paralysis, the animal is able to place weight upon the foot when the limb is placed in position with the phalanges extended.

Prognosis depends upon the cause of injury.

Treatment consists of rest in slings whilst paralysis is complete, and repeated blistering. Subsequently exercise helps to restore the action of the affected muscles.

Paralysis of the External Popliteal Nerve.—*Causes.*—Usually injury to the thigh from falls, accidental or bullet wounds. It has been known to follow strangles. In cattle particularly it may occur as the result of difficult parturition.

In the standing position there may be no evidence that anything is wrong with the animal, though in cases of complete paralysis the hock may be extended and the fetlock flexed with the front of the foot resting on the ground. When caused to walk the flexor muscles are unopposed and so the limb is jerked backwards with the hock extended and the fetlock flexed. It is then brought partly forward, chiefly by means of the extensors of the stifle, and comes to rest with the front of the foot touching the ground. If the foot be placed in position, the animal can usually place weight on the limb.

Prognosis.—In cases where the cause is known to be bruising, recovery may be hoped for, though sometimes several months may elapse before marked improvement appears. Cases occurring in cattle after parturition more commonly affect the left leg, and the animal frequently dies from prolonged decubitus. In those animals that remain standing severe injury may occur to the front of the fetlock and coronet through bruising.

Treatment.—In order to cause the animal to place weight upon the foot a plaster bandage should be applied around the fetlock. Horses may also be shod with a long toe-prong well curved in front. In one case successfully treated a strong indiarubber band was attached from the foot to a rope, a loop at the end of which was tied around the neck. This took the place of the useless extensor muscles, and served to oppose the flexor muscles and helped the limb forward.

Blistering along the course of the affected muscles, and exercise, may be supplemented by local injections of strychnine.

Paralysis of the Internal Popliteal Nerve.—*Symptoms.*—The muscles at the back of the thigh are affected, and so marked flexion of the hock exists. Owing to the fact that the perforans muscle is provided with a long inextensible tendon, flexion of the hock is accompanied by corresponding flexion of the digits. The hock is fixed by the gastrocnemius, and the animal is therefore capable of placing weight upon the limb.

On movement the limb is flexed and the foot is carried high and brought to ground with a peculiar jerking motion.

Atrophy of the muscles at the back of the thigh usually follows.

Treatment.—Exercise and repeated blistering may be tried, but the condition appears to be very intractable, judging from the results of reported cases.

Obturator Paralysis.—*Causes.*—The majority of cases occur as the result of undue traction upon a mal-presentation. Melanotic tumours upon the course of the nerve and pelvic fractures are other causes.

Symptoms.—Marked abduction of the limb and dragging of the foot with a circular sweeping movement. Atrophy of the adductors follows.

Prognosis.—In cattle after calving recovery usually occurs in from three to six weeks, provided that fracture of the pelvis does not exist.

Treatment.—Rest is essential, particularly as there must in most cases be suspicion of pelvic injury. Apart from this, treatment is of little value.

Crural Paralysis.—*Causes.*—Hæmoglobinuria is responsible for many cases showing typical symptoms of crural paralysis, but it is difficult to decide whether the condition is actually paralysis or a myositis. Absence of sensation on the inner surface of the thigh is indicative of true paralysis.

Symptoms.—At rest the affected quarter appears lower than the other, and the limb is flexed. Upon movement this becomes more marked; the whole of the hinder part of the body sinks at every step, owing to flexion of the stifle, hock, and fetlock. The rectus and vasti muscles rapidly atrophy, and when weight is placed on the limb they stand out as thick, tightly stretched cords.

The horse learns in time to fix the stifle-joint and so walks better.

Course.—Paralysis following hæmoglobinuria usually requires from five to six months to restore normal action and to regain the usual size and condition of the muscles. Laminitis in the other hind foot often causes trouble.

Treatment.—Shoeing with heels is helpful, but should not be continued too long. The other hind foot should have the shoe removed, or may be shod with a thick leather with plenty of stopping beneath it. A level field with bare keep, necessitating plenty of exercise, helps to maintain the nutrition of the muscles, as also will blistering at intervals of a few weeks. Injections of turpentine, strychnine, or veratrine may be tried; sometimes they are beneficial. Internally, strychnine, iron, and arsenic are useful.

R. H. S.

NERVE INJURIES

Nerves when divided as the result of injury usually unite readily, even when a gap exists between the two ends. In some cases, however, inflammatory changes take place in the divided end nearest to the nerve centre with the production of fibrous tissue, particularly in the nerve sheath. Cicatricial contraction then occurs, with the result that pain is manifested, and should the "neuroma," as the enlargement is called, be present in one of the limbs, lameness will result.

"Neuroma" is a frequent sequel to neurectomy, whilst we have observed neuroma formation follow section of one of the branches of the musculo-cutaneous division of the median nerve occurring in connection with an extensive wound of the forearm. This was accompanied by marked lameness.

As a rule a "neuroma" can be felt through the skin, and its manipulation is attended by evidence of great pain on the part of the animal.

The "neuroma" may be removed surgically after local injection of cocaine solution, or the nerve may be divided just above the enlargement.

Neuroma formation following neurectomy is facilitated by suppuration in the wound and by exercise before healing is complete. If the animal be kept in a stall for ten days following operation the condition will be very rarely met with. Care should also be taken when operating that the nerve is divided as high up as possible, so that the end may retract and not become implicated in the process of healing.

Neuroses.—As a result of nervous disorders, we may meet with, among horses, cases of hyperæsthesia, anæsthesia, and perverted sensibility.

Hyperæsthesia is occasionally met with in various parts of the body, but is commonest in the region of the mane, particularly beneath the collar, although it is apparently in no way due to injury. The animal cannot bear the least touch on the affected area. Anæsthesia is more rare, and is usually associated with paralysis of muscles, though local anæsthesia may exist independent of any other disorder.

Perverted sensibility applies to the condition of non-parasitic "itchiness" without any visible cause. Some horses with clean skin and quite free from any cutaneous lesion will show signs of appreciation when the withers are scratched, and may even lean on the attendant or go to ground, as a result of nervous excitement.

Treatment.—Hyperæsthesia of the neck is palliated by the application of astringents and by sedatives, as cocaine or belladonna ointment. Its cure is, however, only effected by shaving the part and then completely removing the outer layer of the skin by means of the razor and subsequently treating with antiseptic astringents.

Anæsthesia may be overcome by massage, electricity, counter-irritation, and the administration of strychnine.

Non-parasitic itchiness is relieved by washing with strong salt solution or with weak vinegar and carbolic acid. Sometimes an alkaline mixture containing a small percentage of hydrocyanic acid gives relief.

Arsenic may be administered internally and a dose of physic is advisable. Certain foodstuffs may produce skin irritation, and excess of nitrogenous food must be avoided.

Neuritis.—Unfortunately we are not in a position to study neuritis in the lower animals so carefully as can the surgeon who attends a human being capable of explaining his or her symptoms; nevertheless we occasionally meet with cases of lameness to which by a process of exclusion we are forced to diagnose neuritis.

Changes in the sciatic nerve in the horse have been recorded by several observers. Possibly certain cases of obscure lameness may be attributable to the condition affecting one or other of the nerve-trunks. Persistent shaking of the head shown by some horses in harness or saddle has been attributed to neuritis of the superior maxillary nerve at or just within the foramen by which it becomes superficial. In some instances the nerve has been found enlarged or thickened, and its section has been followed by disappearance of the peculiar nodding or shaking of the head.

R. H. S.

DISEASES OF BLOOD-VESSELS

Arteritis. Inflammation of the Arterial Walls.—In the horse we may meet with two forms of arteritis, atheromatous and parasitic.

Arteritis obliterans as met with in the human subject is of rare occurrence in animals.

Atheroma is usually seen in or posterior to the arch of the aorta, but may affect any portion of the arterial system, notably the anterior mesenteric, coronary, digital, and cerebral vessels. It is more common in aged horses.

The lesions of atheroma are only visible upon opening the artery and examining the inner surface of its walls. They may vary from shallow ulcers arising from the shedding of degenerated endothelial cells to raised calcified masses.

The earliest stage is cellular infiltration of the tunica intima. This takes the appearance of small raised, greyish-white spots of irregular size and shape. The infiltrated areas undergo fatty degeneration and may be shed with the formation of ulcers, but more commonly they become calcareous, owing to the deposition of lime salts. The lining of the vessel then bears small bony processes, usually of about the size of a barley grain but sometimes much larger. There are seldom any considerable number present in any area, though cases have been recorded in which the artery has been converted into a bony tube. This latter condition is more common amongst aged persons than amongst the lower animals.

The existence of these lesions in the arterial walls causes a lack of elasticity.

As a result of fatty degeneration aneurism may occur, owing to loss of elasticity and a tendency to stretch. The walls of the vessel, at first thickened and leathery in appearance, now become quite thin, and the tension within the degenerated walls may be sufficient to cause rupture.

There is also a possibility that death may occur from embolism, resulting from the entrance of cast-off degenerated tissue or fibrinous deposits into the blood stream.

Verminous arteritis denotes inflammation of the walls of an artery arising from invasion by worms. The commonest situation of the lesion is the anterior mesenteric artery, but the aorta itself is not uncommonly affected. The parasite responsible for these changes is *Strongylus vulgaris* (see "Parasites").

The invaded vessel at first becomes thickened, then degenerated, and assumes the appearance of wet chamois leather. Its elasticity is lost and so aneurism results. Fibrin becomes deposited upon the lining of the dilated vessel, and in this layer the parasites embed themselves. The final result of these changes is that the blood supply to portions of the bowel becomes diminished and the animal suffers from colic, diarrhœa, and emaciation. In colts particularly, similar changes may occur in the aorta and may produce symptoms of paraplegia. In cattle atheromatous arteritis occurring in the region of the aortic valves may accompany Johne's disease or other debilitating conditions. In dogs it is rather more frequently observed, and is particularly common in the large breeds.

Treatment of arteritis is more or less useless. The most that we can do is to attempt to maintain strength and energy by careful dieting and hæmatinics when indicated. Digitalis may assist the heart to perform its increased labours. Iodine has been recommended, and in verminous arteritis may be employed with advantage in thirty-grain doses, once daily, combined with nux vomica and digitalis.

Aneurism.—Aneurism may be true or false.

A true aneurism is a circumscribed dilatation of the wall of an artery. Occasionally true aneurism of the heart wall is met with also.

A false aneurism arises from wounding of an artery without perforation of the skin. The vessel then bleeds into the areolar tissue, and thus a cavity may be produced the walls of which become smooth and fibrinous. Should the wound in the arterial wall remain permanently open, a false aneurism is produced and can be recognized by its pulsation.

A "dissecting aneurism" is said to exist when blood forces its way between the tunica intima and media.

True aneurism may be cylindrical, fusiform, or sacculated. It is more common in man than in the lower animals, with the exception of worm aneurism, which is very common among equines.

In the dog, aneurism of the posterior aorta occurs, particularly in old animals. When of considerable size, pulsation may be detected by palpation of the sub-lumbar region.

Aneurism is almost invariably the sequel to pre-existing disease of the vessel wall, and in the horse parasitic invasion is usually responsible.

Worm aneurisms are usually found in the anterior mesenteric artery and at its origin from the inferior aspect of the aorta at the first lumbar vertebra. They are frequently multiple, but rarely of any considerable size. Owing to the deposition of fibrin upon the inner surface of its walls and the presence of parasites, the swelling differs from that seen in aneurism arising from other causes, in that pulsation is seldom discernible and the enlargement upon palpation appears almost solid. Aneurism of the aorta from the same cause is sometimes observed.

The dangers of worm aneurism are not to be disregarded. Rupture sometimes occurs, particularly during the early stages of the aneurism, but it is by no means common. Colic, diarrhœa, and emaciation may result from partial blocking of the anterior mesenteric artery, whilst complete obstruction of one of the smaller branches may occur from cast-off portions of the thrombus becoming lodged therein. By this means colic may be produced, lasting for days and terminating in necrosis of a small portion of intestine or by the establishment of collateral circulation. Recovery is, however, the rule, as before necrosis occurs the blood supply is usually partially restored by shrinking of the thrombus. Particles of thrombus material often containing worms may also become attached in other vessels, as the aorta, whilst portions detached from an aortic thrombus may become lodged in the iliac arteries.

The surgical treatment of aneurism is usually, owing to its situation, futile in equine and exceedingly difficult in canine patients. The administration of iodide of potash or iodine may be of some service in worm aneurism. Treatment must follow the lines laid down in the case of arteritis.

Thrombosis.—By the term thrombus we mean a blood-clot which has formed within the heart or blood-vessels during life.

A thrombus may therefore be cardiac, arterial, or venous.

The chief difficulty in post-mortem examination of an intravascular blood-clot is to determine whether coagulation took place after or prior to death. It is quite common to find large parti-coloured clots filling one of the cavities of the heart and extending into the large vessels, but it does not at all follow that coagulation occurred before death. The chief deciding point is the attachment between the coagulum and the endocardium, and it must not be inferred that blood-clots which are only with difficulty removed from the cavity of a ventricle are necessarily adherent and therefore of ante-mortem occurrence, as entanglement with the chordæ tendineæ may lead to error.

Thrombi may be red, white, or parti-coloured. Red thrombi are composed of ordinary blood-clot, white are fibrinous, whilst parti-coloured are mixed; sometimes this is due to infiltration of blood into a white fibrinous thrombus.

The causes of thrombosis may be injury to or disease of the endothelium, or the detachment of particles of other thrombi which become lodged in another vessel (embolism) and form the nucleus for the formation of a fresh thrombus.

Injury to the lining of a vessel from contusion, stretching, wounding, infection, etc., results in the deposition of blood-platelets and leucocytes at that spot. These apparently develop that elusive body termed "pro-thrombin," which in the presence of lime salts produces thrombin, the resulting coagulation of blood giving rise to local obstruction of the vessel, which may be partial or complete.

Thrombi are more commonly met with in veins than in arteries, as these vessels possess thin walls which are more liable to injury and the circulation within them is more liable to become stagnant.

Thrombi tend to shrink, and so a vessel totally occluded may again become moderately useful with a small passage for the flow of blood. Indeed, at a later stage the whole thrombus may become absorbed, provided that it has not been of any great size. As a rule, however, calcification occurs with the production of "phlebolites" or vein stones, or the thrombus may become organized and fibrous.

Infected thrombi usually disintegrate and give rise to embolism or pyæmia.

Iliac Thrombosis.—Thrombosis occurring in the iliac arteries or at their point of origin from the posterior aorta is by no means rare in horses. A similar condition is sometimes met with in the brachial artery and produces symptoms in the fore limb similar to those caused by iliac thrombosis in the hind ones.

The deposition of fibrin may commence in the terminal portion of the aorta or in any one of the four iliac arteries. When the former is the case the clot usually extends into each of the iliacs in addition. The vessel is at first only slightly obstructed, so that the onset of symptoms may be gradual. At first the occlusion of the artery is only partial, but it may become complete. As a rule symptoms appear, gradually reach a maximum intensity, and then become rather less severe but permanent as shrinkage occurs in the thrombus. A thrombus once developed is seldom, if ever, absorbed, although portions may become detached and produce embolism lower down in the limb.

The causes of iliac thrombosis are not very clearly understood in all cases. Possibly strongyles are responsible in some cases; in fact they have been found in the thrombi on post-mortem examination in a few cases. Some veterinarians regard the condition as occurring as the result of changes in the endothelium, arising from the presence of the toxins of influenza, strangles, etc., but it is difficult to conceive why such a limited area and so constant a position should be attacked.

The symptoms are very characteristic. At rest the animal shows nothing unusual, and when the thrombus is of small size lameness may not become evident until the horse has been trotting for several minutes. The lameness may be more apparent whilst the limb is being advanced or whilst at rest. In the former case the thrombus usually lies in the femoral artery and causes deficiency of blood supply to the extensor muscles; in the latter the thrombus usually lies in the external iliac artery and cuts off the blood supply to the gluteal muscles and to the quadriceps femoris.

The leg is then unable to bear weight, as all the lower articulations become flexed and the symptoms then resemble those of crural paralysis, excepting that there is evidence of severe pain upon exercise and no disability on the part of the animal whilst at rest in the stable.

Sometimes the condition is bilateral, and in a few cases recorded the thrombus has been capable of moving across the aorta from one iliac artery to another.

The lameness is accompanied by severe pain when exercise is forced. The animal sweats profusely, whilst the affected limb remains dry; he looks round anxiously at his hind quarters, and if forced to continue his pace, eventually falls to the ground.

In thrombosis of the aorta or bilateral iliac thrombosis the animal can frequently remain standing for short periods only. Sometimes cardiac disorders occur in conjunction with the condition, owing to increased opposition to the heart's impulse. The veins of the limb are also engorged, as there is less pressure from behind to force the blood upwards on its way to the heart.

Diagnosis can be confirmed by rectal exploration and by lack of pulsation in the arteries as compared with those of the opposite limb.

Treatment.—As the only hope of recovery lies in either the establishment of collateral circulation or absorption of the thrombus, exercise must be continued daily until lameness appears and then ceased until the animal can again proceed without pain. Potassium iodide may be employed internally, and thiosinamine preparations might be given a trial by intramuscular injection.

Treatment is, however, almost invariably futile.

Phlebitis.—Inflammation of a vein is much more commonly met with than is arteritis, as veins have thin walls, are more superficially situated, and are therefore more prone to injury.

Since the passing of the days when bleeding from the jugular vein was considered indispensable to the treatment of animal ills, phlebitis has become much less common.

The cause is usually injury, and in the majority of cases wounding of the vein precedes phlebitis. There are two recognized forms: (i.) simple phlebitis; (ii.) suppurative phlebitis. The result of injury to the wall of the vein is the formation of a thrombus within its lumen. The degree of infection occurring at the time of injury and during the process of healing will decide whether the thrombus will remain sterile or will break down and form pus. When the breach in the wall of the vein does not close immediately after the infliction of the wound, and particularly when a blood-clot forms between the skin wound and the vein, infection is almost sure to follow.

Injuries to the jugular region unassociated with actual wounding may result in peri-phlebitis and possibly in aseptic thrombus formation with a risk of embolism.

Symptoms.—The skin wound instead of uniting by first intention discharges a serous or sanguinolent fluid. Local swelling increases until the lips, face, and sternal region appear deformed in severe cases. The jugular vein can be felt hard and cord-like, owing to the presence of a thrombus within it. After a few days, should infection be not very virulent, the swelling will subside, collateral circulation will be established, or the other vein will perform increased work and the thrombus will contract, drawing the vessel with it into a thin cord. Thrombus formation can always be detected by inability to "raise" the jugular by pressure on it near the chest. Sometimes a small passage may be left in the vein after contraction of the thrombus has occurred.

If infection be severe the swelling will not diminish, but pus formation will develop within the thrombus and at the seat of the wound, whilst by extension to the outer coat of the vein suppuration will occur at various parts of the jugular furrow and thrombus formation may extend up the vessel for a considerable distance. Sometimes broken-down portions of thrombus from the lower end of the vessel become carried into the circulation and cause embolism, or pyæmia may result from the dissemination of pus organisms by the circulation.

Treatment.—Simple phlebitis requires hot fomentations along the course of the vein and the application of iodine tincture to the skin wound. A dose of physic and a course of mashes must also be provided. The occluded vein should not be probed or otherwise interfered with, and no treatment is likely to render it patent.

Septic phlebitis requires drainage, though in cases where it is possible to locate the ends of the thrombus the vein should be ligatured both above and below it. It may then be opened for an inch in length at several points between the ligatures, or a long probe may be passed through it and may be used to draw through its length a perforated rubber drainage tube through which antiseptics may be injected daily. Some practitioners prefer to remove the vein. This may usually be accomplished by dividing the vein below the ligature after longitudinal section of the skin of the jugular furrow and exerting moderate traction.

Phlebolites or vein stones are calcareous thrombi composed of phosphates of lime and magnesia, sometimes found in dilated veins.

Varix.—Varicose veins are very uncommon in the domesticated animals.

The saphena vein sometimes shows dilatation, the so-called blood spavin. We have observed a mass of varicose veins as large as a cocoa-nut beneath the skin covering the extensor muscles of a mule just above the hock.

Operation was attempted, but it was found impossible to locate the vessel, which filled the varix, and although needles were inserted deeply and tight ligatures applied over them, the vessels filled as before. On post-mortem the limb was found honeycombed in this region with thin-walled vessels the diameter of a penny which branched in all directions. Pressure on the saphena and metatarsal veins produced no diminution in the size of the enlargement during life.

Varicocele is met with in many stallions, particularly those of advanced age. Castration is the only remedy, and it will usually be found necessary to ligature the veins separately, as the cautery does not stop the flow of blood backwards past the valves, which are rendered useless by the dilatation of the vessels.

Hæmorrhoids. Piles.—These are very rarely seen in the larger domesticated animals, though they occasionally occur in old, fat dogs. External piles may be removed by ligature. In the horse, and particularly in the mule, folds of mucous membrane of the rectum may project through the anus and become congested from becoming trapped in the sphincter and from exposure to the air. This induces straining and aggravates the condition. These are not true piles, but they produce similar symptoms. If ligatured, prolapse of the rectum may occur from straining, and unless they cause serious inconvenience it will be found advisable to leave treatment alone. Sometimes bathing with astringents may be beneficial, although relief may be only temporary. A severe case in a mule was treated under chloroform by drawing out the first inch of the rectum by traction on the mucous folds and subsequently performing amputation after inserting multiple ligatures. For the first three days defæcation was assisted by clysters. The animal returned to work on the ninth day, healing being complete.

Rupture of Blood-vessels.—Rupture of the anterior mesenteric artery may occur as the result of aneurism formation arising from the presence of strongyles. It is not a common happening, but we have observed two cases in colts. Both animals were found dead. Internal hæmorrhage may accompany various congestive conditions. Bleeding from branches of the pulmonary arteries is sometimes met with in horses affected with chronic emphysema of the lung tissue. We have observed two cases in each of which hæmorrhage ceased, but was renewed on the following day with fatal consequences.

Hæmorrhage from the nasal cavity (epistaxis) may arise from over-exertion, as in racehorses, with fatal results in rare instances. Hæmorrhage is likely to recur with violent exercise.

Sudden violent hæmorrhage is accompanied by rapid blanching of the visible mucous membranes, depression, sighing respiration, yawning, and finally rambling movements, decubitus, and death. Dogs and cats may die within two minutes from rupture of the aorta following external violence.

The treatment of most service is the hypodermic administration of a large dose of atropin. Adrenalin injected hypodermically is also useful as a preventive. Cold water may be thrown over the animal as an emergency measure, sometimes with good results.

Lymphangitis.—This is almost invariably the result of the admission of either bacteria or bacterial products into the lumen of the lymphatic vessels. The diseased condition extends in a centripetal direction, as from the foot when the subject of bacterial invasion, upwards towards the thigh or shoulder. The lymph vessels themselves become both dilated and thickened, so that they are easily visible beneath the skin in an acute attack, but chronic lymphangitis is usually associated with marked thickening of the skin, so that the course of the vessels is masked, even when they are greatly dilated.

In severe or prolonged cases inflammatory changes extend beyond the walls of the lymph vessels, with congestion of the capillaries and extravasation into the subcutaneous tissues.

Lymphangitis is almost invariably a complication of septic wounds of the extremity, and is also particularly common in connection with wounds of the trunk caused by friction of the harness. Punctured soles and nail pricks may be attended by lymphangitis extending as far as the thigh or armpit.

The distension of the lymph vessels usually extends as far in a centripetal direction as the nearest group of lymphatic glands. Sometimes suppuration occurs in these and also at various points on the course of the vessels, and occasionally the resulting changes so diminish the efficiency of the glands that pus-organisms find their way into the general circulation and thereby set up pyæmia.

It is not uncommon to see successive small abscesses develop on the course of a lymphatic vessel as the result of a foot injury or of a tread or wound of the heel or coronet. Each abscess appears at a somewhat higher level than the last, until the axilla or thigh is reached, when the glands usually become involved in the suppurative process.

In cattle, tuberculous deposits sometimes occur in the limbs, appearing as chains of small swellings the size of a hazel nut or sometimes of a walnut. If incised a soft caseous material exudes, and in long-standing cases gritty particles are present, or the whole mass of material may be calcareous. Tubercle bacilli are visible in the cheesy matter upon microscopical examination. The condition is not attended by local inflammation.

Treatment.—Internally iodide of potash and biniodide of mercury may be prescribed with good results, whilst elimination should be accelerated by aperients and diuretics. In chronic cases iodide of iron with arsenic or Donovan's solution may be employed. In suppurative lymphangitis intramuscular injection of nuclein solution may be beneficial, and when possible an autogenous vaccine should be made use of.

Locally hot fomentations and massage in a centripetal direction assist the flow of lymph, whilst subsequent light friction with a liniment containing camphor and belladonna diminishes the pain and soreness.

The sheet-anchor of treatment, however, lies in thorough disinfection of the wound. Wounds of the foot should be thoroughly pared out and dressed with 10 per cent solution of perchloride of mercury in spirit. Other wounds may be well curetted and dressed with suitable antiseptics or plugged with powdered permanganate of potash, which gives excellent results.

Suppurating centres should be freely opened and treated with antiseptics. R. H. S.

SURGICAL DISEASES OF THE ABDOMEN OF THE DOG AND CAT

Under this heading there will be dealt with a series of operations which are of practical value in the case of the smaller animals, and which have been performed successfully (thanks to our improved knowledge of the use of anæsthetics and the value of antiseptics) a very large number of times.

Tumours of the abdominal wall are not uncommon, but are dealt with like tumours elsewhere. Commencing with the cavity of the abdomen itself we have the operation of simple puncture (*paracentesis abdominis*) for ascites. This is performed for **ascites,** an ailment much more common in the dog or cat than in any other of the domesticated animals.

In so far as the actual operation itself is concerned, provided the usual antiseptic precautions are taken, there need be no fear of performing it, but the proportion of cases of permanent recovery is small. The life of the animal can be prolonged, and, if the patient is not old and the liver and kidneys are not severely diseased, there is always the chance that the ascites may not return; and as it offers the only chance of cure and the operation is not a painful one, it is always worthy of a trial at least once, or even two or three times.

The *linea alba* is in my opinion the best situation in which to perform the operation.

Accidental Wounds.—These are of common occurrence in dogs and cats, the combative nature of these animals, together with their proclivities for jumping over palings and other things, and getting in the way of vehicles, being common causes. Gunshot wounds, too, are not infrequent in sporting dogs. Formerly the majority of such animals would at once have been destroyed as painlessly as possible, but experience has taught that nowadays, with modern appliances and up-to-date knowledge, the patient stands an excellent chance of recovery if attended to at once, and provided that the internal organs are not dirty or too severely damaged. Peritonitis is the sequel to be dreaded, but many cases have been recorded during the past ten or fifteen years in which the intestines have been exposed by injury and the patient has afterwards made a good recovery.

The treatment to be adopted is at once to anæsthetize the animal, shave and thoroughly cleanse the wound, cleanse and replace any intestine or other organ which may be prolapsed separately, draw the muscles and skin together with sutures and support with a bandage. Afterwards treat as an ordinary surgical case.

Food should always be given sparingly and care taken that the animal is kept perfectly quiet until firm union has taken place.

Laparotomy may be performed as an exploratory measure with a view to finding out the condition of things in the interior of the abdomen, and it is, of necessity, the preliminary step to any operation involving attention to the organs inside.

The situation in which to enter the abdomen must depend somewhat upon the operation to be performed, but wherever it is possible I prefer to perform abdominal section in the dog through the *linea alba.* The incision is bloodless and the edges of the wound lend themselves very satisfactorily to the application of sutures and to primary union afterwards. In the cat, however, experience has taught me that the flank situation gives the best results, because of the crouching position assumed by this animal when kept in a cage. Adhesion between the wound and the internal organs is not so likely to take place as when the *linea alba* site is employed. It is astonishing how much exploration the abdomen will stand, provided ordinary care is taken when handling the organs, and strict attention has been paid to antiseptic details.

With **gunshot wounds,** if extensive but not yet fatal, the patient is usually in such agony that it is better to be destroyed. If slight, it is questionable whether it is wise to do much exploration, the external wounds being antiseptically dressed and rest and dietary attended to. If the stomach, intestine, or liver is injured the prognosis is grave, and exploratory laparotomy alone can reveal the amount of injury sustained. Repair of the injured organs may be possible, especially in the case of the stomach, but if any quantity of contents of either the stomach or intestine has escaped into the peritoneal cavity the probability is that fatal peritonitis will ensue and the most humane way is to allow the patient to pass away before coming out of the anæsthetic.

Foreign Bodies in the Stomach and Intestines.—Dogs frequently swallow foreign bodies such as stones, rubber balls, meat-skewers, hat-pins, needles, nails, corks, coins, pieces of stick, and many other curious things too numerous to mention. Kittens (and cats too) often swallow pins, and even ladies' hat-pins, cotton thread, beads, tape, bits of cork, and fish-hooks have been found in the intestine on many occasions.

The greed of the animal is well characterized by its successful endeavour to swallow the wooden skewer together with the horse-flesh impaled upon it, when another animal tries to take away the dainty morsel. The finding of the "cat's-meat skewer" in canine patients is so well known amongst practitioners in London that it is always inquired about before diagnosing certain classes of cases; and as regards stones the author had one patient (an Aberdeen terrier) who swallowed on one occasion no less than 114 stones, all of which were eventually got rid of. In another instance a dog was seen to swallow a peculiar-shaped stone on December 13, and the same stone was vomited back in the owner's presence on February 12 following. The author on one occasion removed a two-shilling piece from the stomach of a dog, the coin having been swallowed two years previously. It had made a small sac for itself at one end of the stomach.

In all patients suspected of swallowing foreign bodies a thorough manual examination should always be made before any operation is undertaken. The history given by the owner cannot always be relied upon and should always be questioned in every detail, as it is very annoying to make an unsuccessful laparotomy for a lost ball and then find it afterwards in a corner of the room. The Röntgen rays are of especial value in these cases and are utilized freely in all places where the apparatus is accessible.

The chief signs exhibited are: attempts at vomiting, capricious appetite or total disinclination to feed, general dulness and depression, and, in a later stage, unthriftiness of the coat, irregularity of the bowels, dysentery, and emaciation.

Treatment.—For small bodies, such as nails, etc., after a dose of apomorphine or some emetic medicine, some solid dietary (such as suet pudding) of the stodgy variety, which will surround the foreign body and gradually pass it along the intestine, is required. This is followed up by a dose of aperient medicine, castor or olive oil being the best.

With skewers, hat-pins or needles, if the patient is not suffering any great inconvenience, the better plan is to await developments as the point will in a few days make its way to the surface, causing an abscess. This is lanced when ready and the foreign body extracted. The head of such a substance as a lady's hat-pin may either be cut off close and allowed to fall back into the stomach or intestine (from which it will eventually be passed) or the orifice carefully enlarged and the head withdrawn. The former is preferable; as a rule adhesion has already taken place between the internal organ and the peritoneum, so that the peritoneal cavity proper is not really opened, and if the abscess cavity is carefully cleansed the patient usually makes a rapid recovery. If a major operation is necessary either the stomach or the bowel may have to be incised and either a *gastrotomy* or an *enterotomy* performed.

For gastrotomy an incision is made about two or three inches below the cartilage of the sternum under, of course, an anæsthetic and the usual antiseptic precautions.

The stomach is drawn up outside the abdominal wall and allowed to rest on a piece of sterilized mackintosh (or jaconet) and carefully packed around with sterile lint or cloths, the foreign body being sought for and brought close up against a portion of the wall where the blood-vessels are small or absent, and an incision is made directly over it. If the stomach is at all distended with gas, a small trocar and cannula should first be used to allow this to escape.

The foreign body is extracted, the internal edges of the wound carefully cleansed with antiseptic solution, and a close row of silk sutures (Czerny-Lembert or Lembert pattern) inserted with a small, round, milliner's needle. The stomach is then carefully replaced and the laparotomy wound of the skin and bowels treated in the usual way.

Sometimes a foreign body which has become stuck fast in the lower part of the œsophagus can be reached through an incision in the stomach by the aid of a pair of long forceps, and can be removed in this way when all attempts to get it away by the mouth have failed.

For the removal of a foreign body fixed in the intestine the latter is exposed in exactly the same way as the stomach, an incision being made in the longitudinal axis. After the foreign body has been extracted and the intestinal wall sutured after Lembert's method, the intestine is carefully returned to the abdomen and the muscles and skin are sutured in the usual way.

Intussusception of the Intestine.—This is a common condition amongst puppies, and it usually follows as a sequel to the violent peristalsis set up by some irritant such as indigestible food or worms. It can be felt quite readily in a thin dog as a sausage-like swelling which rolls about between the finger, and the diagnosis is helped by the symptoms shown by the dog. The eyes are bright, but the patient withdraws out of sight away from its companions and is continually straining. There may even be jaundice as a complication.

Surgical Interference.—The performance of laparotomy and the actual straightening out of the bowel gives most excellent results if adhesion has not already taken place. If the latter has occurred and it is very firm enterostomy is the only solution.

Fæcal Impaction of the Intestine.—Obstinate constipation and impaction of the intestine by hardened fæces are very common troubles in the dog and cat, especially those of unclean habits and belonging to inattentive owners. Aperients and enemas of warm oil and water will usually put matters right, but occasionally surgical help has to be obtained. Over-indulgence in game and rabbit bones is a fruitful cause, and these, matted together with fur or hair, form a mass which is very hard to dislodge.

In each of two cases met with by the author the animals (retrievers) had passed no fæces for three weeks before the mass was removed.

The colon is usually the part of bowel affected, the mass being felt from the exterior by palpation of the abdomen or per rectum. The patient is capricious in appetite, finally refusing food altogether and being persistently sick, frequently attempting to pass fæces with no result. After an attempt the poor beast will look around at its flanks and stand rigidly still. The coat is unthrifty, and after a few days the animal gets visibly weaker.

If all efforts to remove the mass by medicinal means fail, laparotomy should be performed, and the obstructed bowel kneaded gently by the ends of the fingers until the contents are broken up and able to be passed on into the rectum. The greatest patience is required, and care must be taken not to injure the bowel wall with the nails during the kneading process, as it is easily ruptured. It is a good plan to try first at one end and then the other, gradually working towards the centre or any place which seems softer than its surroundings. If relief cannot be obtained in this way the operation of enterotomy (opening the bowel) or that of enterectomy (removing a piece of gut) and subsequent anastomosis must be resorted to.

Once the obstruction has been removed the attention of the surgeon has to be directed to an attempt to make the bowel resume its normal tone and become strong again. For this purpose the diet must be of easily digestible materials, such as milk or broth or finely-minced raw meat, given in small quantities and often. Rectal feeding is also a help, and when once convalescence has commenced recovery is usually rapid.

Stricture of the Bowel.—This is not a common condition in the dog or cat, but has been observed on several occasions. Enterostomy is the only thing which is likely to give relief, but as a general rule the most humane course is to put the animal painlessly away.

Strangulation of the Intestine.—This accident is always to be dreaded in hernia cases and frequently follows a greedy full meal. Sometimes it can be relieved by gentle massage, but if that fails an operation should be done without delay. Under anæsthesia the strangulated bowel is cut down upon and manipulated carefully until it can be returned.

Tumours of the Stomach and Intestine.—These are comparatively rare in the dog and cat, but carcinoma and sarcoma have each been recorded.

Prolapse of the anus and bowel is a condition which is frequently met with in young dogs and cats, and is very troublesome to deal with. It may consist merely of inverted rectum, or the colon may be protruded through the anus. Treatment consists in returning it carefully, and, if necessary, a purse-string suture may be applied. Light dietary and keeping the patient quiet are essential, for at least a fortnight or three weeks afterwards.

Notwithstanding all precautions one sometimes meets with a case in which the intestine is persistently protruding; and for this operative interference is necessary. Three courses are open: one is to apply Gersury's operation, and insert four pillars of paraffin wax subcutaneously around the anus, and a second is to perform amputation. The former is preferable to commence with, for its results in the dog have been splendid, and in a high proportion of cases it will prove successful.

The third course is to perform laparotomy, and suture the bowel to the interior of the abdominal wall. The results of this operation are very good.

Imperforate anus and the **presence of a cloaca** are congenital deformities sometimes met with. Each is cured only by operative interference.

Obstruction of the Anal Glands.—This condition is a very common one in the dog, and its removal gives almost instantaneous relief. The anal glands are two pouches, one on either side of the rectum, opening into the latter by small orifices which are found just inside the anus.

The patient continually licks or rubs along the ground, and examination of the part reveals it to be swollen and sore. Temporary relief can be obtained by the application of gradual pressure between the thumb and finger. For obtaining permanent relief the better plan is to remove the whole of the affected gland, or at all events to curette the interior thoroughly. It is a simple operation under an anæsthetic, and the relief given to the dog is simply enormous.

Tumours of the Abdomen and Abdominal Organs.—Sarcoma and carcinoma are most commonly met with, and as each is malignant the patient should (when the diagnosis is confirmed) be at once humanely destroyed.

A lipoma or any tumour which is non-malignant and can be got away should be removed under anæsthesia either by ligature or by the ecraseur.

Hernia.—All varieties of hernia are met with in the dog—scrotal, inguinal, umbilical, ventral, perineal, and femoral. The first three are hereditary, but the last two are often caused by an accident.

In young animals it is astonishing how much can be done by constant manipulation and rest, but operative interference is undoubtedly the quickest method of making a permanent reduction. This has been dealt with in another section (see "Hernia").

Cystitis.—Cystitis or inflammation of the bladder is particularly common in old dogs, and in cats it is most frequently met with in the castrated male. Tumours, calculi, and the deposit of sabulous material are the most frequent causes; and septic organisms may gain access through the passage of a dirty catheter. Overdoses of irritant medicines (such as cantharides) will cause bladder irritation and cystitis.

The symptoms shown are continual restlessness and constant attempts at urination, during which a few drops only are passed. This may be discoloured or blood-stained, and if relief is not obtained the appetite becomes capricious, and the patient feverish and emaciated. Examination by palpation through the abdominal wall and by means of a flexible metal sound or a catheter should be made, especially in order to detect the presence of calculus, when operative interference is necessary. If septic organisms are suspected the bladder must be washed out with warm boric acid, chinosol, or weak formalin, and urotropine, buchu, creolin, hyposulphite of soda, hyoscyamus, potassium carbonate, or some other drug at the selection of the practitioner, administered by the mouth.

Tincture of cantharides in small doses sometimes gives relief at once in hæmaturia, whilst pearl-barley or linseed-tea forms a useful demulcent.

Tumours of the Bladder.—The most common are papilloma, sarcoma, and carcinoma. Myxoma and fibroma have also been met with. They may be suspected by the presence of hæmaturia, by pain and irritation when urine is passed, and by the fact that urination is more frequent.

In the later stages the patient becomes emaciated, and the urine may be fœtid or purulent.

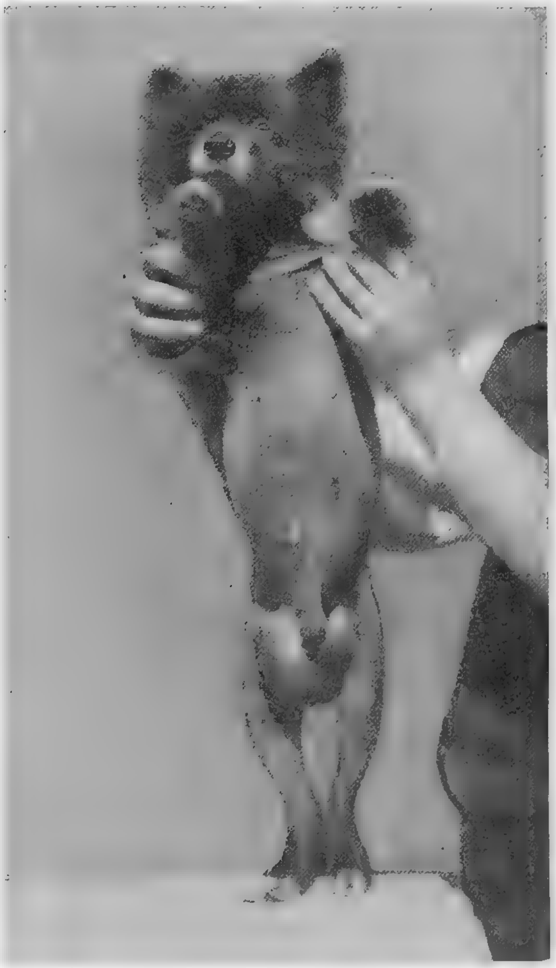

FIG. 167.—Carcinoma of testicle. (G. H. W.)

The bladder should be washed out with a warm solution of boric acid, eusol, chinosol, or some non-irritating antiseptic containing a little sedative such as belladonna or opium, and internal sedatives such as urotropine or hyoscyamus administered. Failing relief from these, surgical aid must be invoked.

Calculi.—These are frequently met with in old dogs, and may be as large as a large walnut, one calculus only being present, or there may be numerous small ones. In one instance the author found no less than eighty-four stones in the bladder of a dog. Small calculi often give trouble by getting into the urethral passage.

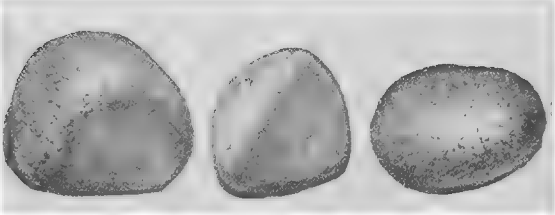

Fig. 168.—Shapes assumed by calculi in the bladder of the dog.

Experience has taught that as a rule calculi grow to a larger size in the bitch than in the dog. They may be round or oblong in shape, or triangular and facetted by rubbing against one another. In any case surgical methods are essential to give permanent relief, and lithotomy or lithotrity should be practised.

Suprapubic lithotomy is performed as follows: Empty the bladder with a catheter and wash out with a solution of warm antiseptic such as boric acid or chinosol. Anæsthetize the patient, and perform laparotomy in the pelvic region. Carefully raise the bladder and pack securely outside the abdomen on sterilized lint. Incise longitudinally in the centre in the least vascular portion, as near as possible directly over the stone, which is then very carefully loosened from any attachments it has to the mucous membrane and removed. If a number of small stones are present these are extracted by the aid of a blunt scoop or spoon. The bladder is then carefully wiped out, and the edges of the wound drawn together with silk sutures of Lembert pattern, the laparotomy wound being sutured in the usual way. The patient is kept quiet for several days and fed sparingly, and as a rule the wounds heal *per primam*.

In the bitch it is frequently possible to dilate the urethral orifice sufficiently to remove the calculus without opening the abdomen. It may be removed whole or after being crushed with a lithotrite.

Sand or sabulous matter is frequently met with in the castrated cat, and is apt to give trouble, and even to cause cystitis and death if not removed.

Inflammation of the Prostate Gland.—The prostate gland is situated on the neck of the bladder, and in old dogs is apt to become enlarged and, by causing pressure on the urethra, to give rise to pain and obstruct the flow of urine. It may even suppurate and cause septicæmia, or the abscess may burst into the abdomen and cause peritonitis.

It can readily be felt per rectum, as a two-lobed body, about one or two inches from the anus. When inflamed it gives rise to excessive pain, especially when there is constipation present; the patient looking very anxious, with capricious appetite, and having difficulty in passing urine. Warm opiate enemas, combined with gentle laxatives followed by the administration of urotropine or hyoscyamus, will give temporary relief, but the best permanent results are obtained from castration. The relief given is observable within ten days or a fortnight, and in course of time the lobes of the prostate will atrophy. The result, too, is permanent.

The Ovaries and Uterus.—As these organs are situated in the abdomen it is necessary to allude to them under the title of abdominal surgery. They are frequently interfered with by the surgeon, and very often removed *in toto*.

Under anæsthesia and existent antiseptic precautions the surgery of the ovaries and uterus can be practised with most successful results.

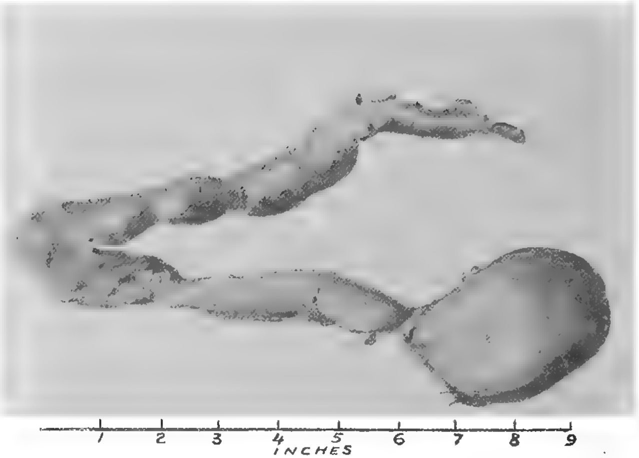

Fig. 169.—Diseased uterus and ovary from bull bitch. (Hobday.)

The horns were full of pus. The right ovary was normal, weighing 8 grs.; the left ovary was diseased, weighing 2¾ ounces.

In cases of dystokia, purulent metritis, tumours of the uterus or ovaries, for ovariotomy or oöphorectomy the surgeon nowadays removes the whole (or a part) of the generative organs of the bitch or cat without the slightest hesitation.

For further details see "Ovariotomy" and "Ovaro-hysterectomy."

F. T. G. H.

DISEASES OF THE EYE

I. Examination of the Eyes

In the course of an examination of animals for soundness by a veterinary surgeon, prior to purchase by a client, the examination of the eyes is an important item. This is especially so in the case of the horse, and particularly with regard to hunters and thoroughbreds, in which, failing a full certificate of soundness, one of soundness "in eyes and wind" is a material factor in determining the value of the horse.

Good sight and sound eyes are important in all horses used for riding purposes, thoroughbreds especially, 'chasers, hunters, Army rides, and hacks; and also in horses driven in single harness. Similarly in sporting dogs sound eyes are essential, and blindness is in all cases a disqualification under Kennel Club Rules.

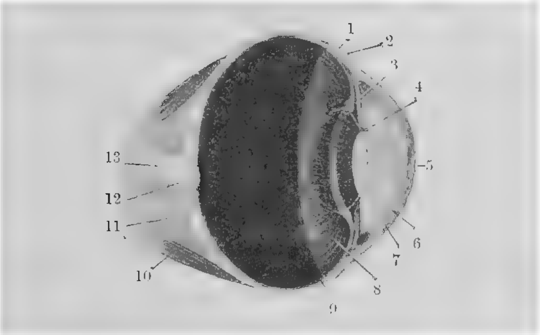

Fig. 170.

1. Sclera.
2. Reflection of conjunctiva.
3. Iris.
4. Granula iridis.
5. Cornea.
6. Lens.
7. Anterior chamber.
8. Ciliary processes.
9. Choroid.
10. Rectus oculi inferior.
11. Retrobulbar fat.
12. Optic papilla.
13. Optic nerve.

The contour of the crystalline lens is dotted.

(From Sisson's *Anatomy of the Domestic Animals.*)

In the horse a cursory examination is made during the preliminary process of "looking over" the horse. During the test for lameness, and whilst moving round about the horse, an observant examiner will detect the characteristic signs of blindness by peculiarities of gait—uncertainty and a tendency to flounder—and by hypersensitive ear movements.

The first serious inspection of the eyes is made when the horse is pulled up after his gallop for testing the wind. The gallop has the effect of dilating the pupil, so allowing a better inspection of the lens.

The horse should be made to stand in a shady place such as an archway so that direct sunlight does not fall on the eyes, the best light being the diffuse light reflected from white clouds. The examiner should be provided with a dull black cloth-covered disc or shield with which to intercept bright light-rays, which cause reflections on the moist glistening transparent cornea, so interfering with a distinct view of the various structures in the eye. It is advisable to make sure that no windows or other possible reflecting surfaces are in such a position as to throw images into the eyes or non-existent cataracts may be certified to and a sound horse condemned.

The eyelids are first inspected for the detection of old wounds or injuries likely to interfere with the lachrymal drainage, for puckering or inversion (entropion), or for angular bends in the lid marginal curve—a frequent sign of old periodic ophthalmia—or for any tumours or cysts. The membrana nictitans is observed particularly to determine the presence of incipient or small tumours, and incidentally to detect any sign of tetanus infection, particularly in recently-docked horses. The conjunctiva will indicate the presence of jaundice, or purpura, or circulatory disturbance.

Attention is then concentrated on the eye as the organ of sight. The cornea is carefully inspected for opacities which, if large and dense are at once detected, but if speck-like, or linear, or very thin and filmy are seen only in certain positions and after thorough search. Such small opacities are unsoundness in the technical sense, and will upset a warranty of soundness. The experienced examiner will, however, exercise his judgment, discriminating between recent thin blue nebulæ—such as result from a flick with a whiplash, and capable of rapid absorption—and dense vascularized old scars. Opacities over the pupillary area will obviously receive more consideration than those close to the limbus. Such partial opacities as are central and likely to cause irregular refraction and duplication of images, so predisposing to shying or to misjudging fences, will be most serious of all. With any recent injury it is important to determine the presence of a wound or ulcer, if necessary by the use of fluorescein solution, since any loss of surface cells must be considered a potential entrance for infection and serious eye disease. In such a case the certificate may be withheld till the defect has had time to heal. The anterior chamber should contain only clear aqueous humour, so allowing an uninterrupted view of the iris. Any turbidity of the aqueous humour, or any deposit of lymph in the floor of the chamber, is a very serious defect pointing to previous ophthalmia. The iris should be inspected as to its lustre, uniformity of colour, the evenness of its pupillary margin, and the entire absence of any raggedness, and for motility when alternately stimulated by bright light and shaded. Abnormalities in these directions point to previous attacks of iritis (*q.v.*). Depending from the upper part of the pupillary margin of the iris are two or more brownish-black bodies of more or less spherical shape—the corpora nigra. Sometimes these are of excessive size—a defect worth mention.

The pupil should be observed to contract and dilate according to the degree of illumination, a permanently dilated pupil pointing to optic nerve defects, a contracted one suggesting iritis, and a pupil with ragged, uneven margin indicating some tying down of the iris to either the lens or the cornea as a result of old iritis.

The lens should receive particular attention in order to determine the presence or absence of cataract. With a large cataract involving the whole or a good part of the lens, dense, white, and woolly, there is no difficulty. The horse is blind in that eye, and all the symptoms and signs are obvious. With a small speck less than a pin's-head and not necessarily in the centre of the lens considerable care has to be taken in its detection. In a moderate diffused light and with a well-dilated pupil the ordinary naked eye examination is in most cases sufficient, but with a contracted pupil it is impossible to say whether there are specks in the lens or not.

Special methods of examination must then be used, and since these are of use in connection with the diagnosis, prognosis, and treatment of various eye diseases they will be described in general terms, the reader applying as much as is necessary to the examination for soundness only.

Focal or Oblique Illumination.—This method is used for the examination of the conjunctiva, cornea, sclerotic, and iris—in other words, for the anterior parts of the eye. It is especially useful for the detection of foreign bodies, and of injuries to or ulcers of the cornea.

Light, whether from a lamp in the dark-room, or in daylight, is focussed on to the eye by means of a double convex lens. The usual lens is one of about + 14 D[1] (such as is usually supplied with the ophthalmoscope). An ordinary reading-glass will answer the same purpose. The lens is placed with its principal axis in a direct line between the source of light and the eye, *i.e.* the two surfaces of the lens are at right angles to this line. By gradually approaching the lens to the eye a position can be found where the light is focussed on to the surface of the eye or into the substance of the cornea, so lighting up these parts and showing up foreign bodies or abnormalities.

Still using the first lens as a means of illumination, one can use a second lens as a magnifying glass, so as to obtain an enlarged image of the illuminated area. The second lens is placed a few inches from the eye in the path of light from the first lens. The surgeon places his eye at the focus of the second or magnifying lens, and by this means minute foreign bodies can be detected and removed.

The Ophthalmoscope.—This consists essentially of a concave mirror of 20 cms. focal length with a central aperture. The mirror reflects convergent rays from the source of light into the eye to be examined. The light-rays are made more convergent by passing through the refractive media, especially the lens, of the eye, and so cross in the vitreous humour, and light up the fundus. From every point of this illuminated surface in the eye rays are reflected back again to the observer's eye which is looking through the aperture in the mirror. Supposing the patient's eye to be emmetropic (*i.e.* neither long-sighted nor short-sighted) the rays emerge in a parallel beam, and if the surgeon's eye be also normal (emmetropic) these parallel rays will fall on his retina in focus, so giving a clearly-defined upright image or picture of the fundus of the eye examined.

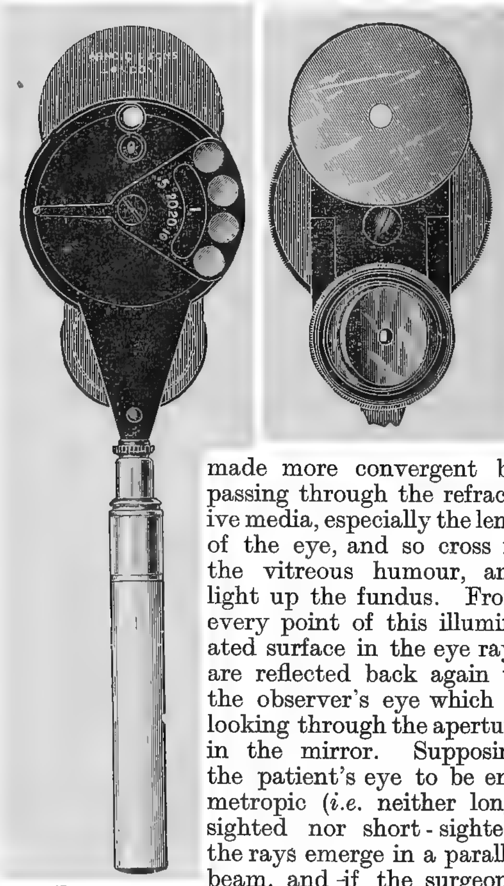

FIG. 171.
Ophthalmoscope.

This is known as the *direct method*. The lamp (if the examination is held in the dark-room) should be on a level with the eye to be examined, and in such a position as to leave the eye in shadow. Thus in examining the horse's near eye the lamp should be placed a little in front of the horse's head and about a foot to the off-side.

The observer's head has to be brought fairly close to the eye to be examined, from as far as 2 feet away down to 6 inches, depending on whether the cornea and lens or the fundus are being examined. The view of the fundus obtained by this method is enlarged, being magnified about 15 diameters in an emmetropic eye. The observer's eye must be at rest, *i.e.* not accommodated at all, but as it were looking into the distance, and this is a matter of practice. The placing of a low concave lens behind the aperture in the ophthalmoscope mirror will help a beginner. Atropine will paralyse and prevent accommodation on the part of the patient.

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[1] Lenses are numbered in diopters according to their focal length. A lens with a focal length of 1 metre (100 cms.) is called a + 1 D lens, and the dioptric number varies inversely as the focal length. Thus, to find the focal length of a lens whose dioptric number is given, the rule is to divide 100 cms. by the dioptric number, and the result is the focal length in centimetres. *Example*:—A lens of 20 D has a focal length of $\frac{100}{20}=5$ cms.

Examination of the horse's eye is more easily and satisfactorily carried out in daylight than in the dark-room. The horse should stand in the stable parallel to an open door or window with the eye to be examined in shadow. The observer then reflects the light from the window into the eye with the ophthalmoscope. The attendant should keep the head as steady as possible by means of one hand on the ear, the other holding the bridle. It is advisable to dilate the pupil with atropine or homatropine drops about an hour before the examination is made. The direct method has the advantages of the upright image and of a high magnification of the parts examined.

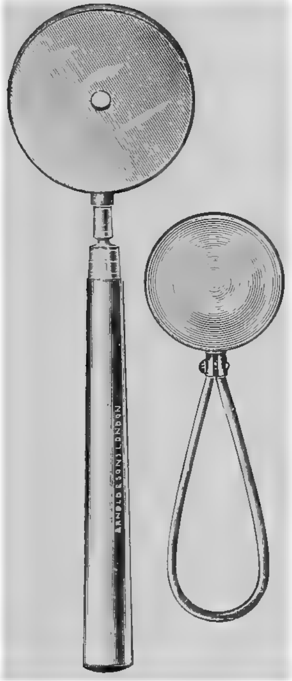

Fig. 172.
Ophthalmoscope and lens.

The *indirect method* allows of a more general view, of much less magnification (4 or 5 diameters), but it is less easy to apply in veterinary practice because of the difficulty of keeping the patient quiet during the observation. In addition to the ophthalmoscope a biconvex lens, usually about 14 D, is also used. It is held at a distance slightly greater than its focal length from the eye to be examined. The rays from the ophthalmoscope are thrown into the eye through the lens. This converges the rays, which cross in the vitreous, illuminate a part of the fundus, and emerge as a parallel pencil of light from a normally-refracting (emmetropic) eye. The rays then pass through the convex lens and are brought to a focus at a point behind it, giving a real inverted image of part of the fundus. This is what the observer sees, and he must accommodate to see this clearly whilst looking at the lens. The procedure is to place the lamp as in the *direct method*, put the ophthalmoscope to the observer's eye, throw a beam of light into the horse's eye until the pupil is lighted up and the greenish-golden reflex from the fundus appears. Then interpose the lens, holding it between finger and thumb and supporting it in position with the little finger against the horse's head. A speculum is usually required, and it is necessary to use both cocaine and atropine in order that the animal may not resent the speculum and the bright beam of light. Two assistants will be required, the one to hold the horse's head, the other to hold the lamp.

Opacities in the refractive media of the eye—cornea, lens, or vitreous—can be detected as black specks in the illuminated greenish field, and as the eye is rotated they move, if in cornea or anterior surface of the lens in the same direction as the eye, if posterior to the centre of the lens in the opposite direction to the eye movements. By close observation of the movements, an idea of the depth of the opacity can be obtained.

In the horse the fundus is seen to be brightly illuminated with a surface of greenish-blue and gold called the *tapetum lucidum*. Below the tapetum and slightly to the temporal side is the round optic disc or papilla—the point of entrance of the optic nerve. This is of a pinkish-white colour. Radiating from the papilla are the retinal arteries and veins—showing as a much closer network in the horse than in other animals. Outside the area of the tapetum lucidum is the dark purple or brown area of the fundus, but it is not very easily examined.

In the ox the tapetum is greenish-blue; in the dog golden-green and scintillating. There is no tapetum in the pig. The retinal vessels are fewer and more distinct in the other animals than in the horse, and the arteries and veins can be distinguished.

An ophthalmoscopic examination not only provides information with regard to small opacities in the cornea and lens, but it is the best means of detecting diseased conditions of the vitreous humour, the choroid, retina, and optic nerve. These are uncommon conditions in the domesticated animals, but they will be discussed briefly under the respective headings.

Retinoscopy for Myopia, Hypermetropia, and Astigmatism.—One further and important use of the ophthalmoscope is to determine the refractive power of the eye, so detecting myopia, hypermetropia, and astigmatism. This is done by the practice of retinoscopy or the shadow test.

When rays of light from a concave mirror are thrown on to the eye the pupil is illuminated by the reflection of the light from the fundus. If the mirror is then slowly rotated round an axis lying in the plane of the mirror, the beam of light moves either laterally (mirror rotated round its vertical axis) or up and down (mirror rotated round its horizontal axis). By this means the non-illuminated edge or shadow bordering on the bright area is made to move across or up and down the pupil, and, by observing the direction of its movement, the refraction of the eye is determined.

Without discussing the theory of retinoscopy, the results may be indicated. Rotating the mirror laterally the shadow may move to the right or to the left, or it may remain stationary. Movement of the shadow in the *same* direction as the mirror is rotated (*i.e. with* the mirror) indicates **myopia.** To determine the degree of myopia, a series of concave lenses of varying strengths in diopters ranging from 5 D to 3 D are required. These are inserted one at a time in a spectacle-frame arranged in front of the horse's eye. Commencing with a low concave glass (say -1D), lenses are tried until on rotating the ophthalmoscope mirror the shadow remains stationary. Then the number of the concave lens used plus 1 gives the degree of myopia in diopters or $M=(n+1)D$, where n is the number of the concave lens and M is the degree of myopia.

Movement of the shadow in the *reverse* direction to the mirror indicates one of three conditions, namely, myopia of less than 1 diopter, emmetropia or normal refraction, or **hypermetropia.** To determine which of these is present and the extent of the abnormality, if any, a series of convex lenses are used. The result is given by the formula $H=(n-1)D$, where H indicates the degree of hypermetropia and n the number of the convex lens used to secure immobility of the shadow. Thus, if the convex lens is 0·75 D the degree of hypermetropia is $-0{\cdot}25$ diopters—*i.e.* there is $+0{\cdot}25$ D myopia. If the convex lens used is 1 D, then $H=(1\text{-}1)D=0$, and the eye is emmetropic with normal refraction. If the lens used is 1·5 D, the hypermetropia is 0·5 D.

If, without using any lens, the shadow remains stationary, the eye is myopic to the extent of 1 diopter, as is seen by using the first formula.

Astigmatism is determined by the same method, the refractive power of the eye being determined for the vertical and horizontal meridians. In examining an eye the refraction may be found normal in one meridian and either myopic or hypermetropic in the other; or the refraction may be abnormal in both meridians, but in different degrees.

The retinoscopic examination is best made in daylight, the horse standing in a stable parallel to a window or open door with the eye in shadow. Atropine or homatropine should be used an hour before the examination begins. The observer stands about one yard or a little further away from the horse's eye. The correcting lenses, instead of being fixed in a spectacle-frame, may be held in front of the horse's eye by an attendant. Another attendant keeps the head steady by holding one ear and also the bridle.

The investigations of different authors as to the common refractive errors in horses give somewhat divergent results. Nicolas in France found the majority of horses slightly hypermetropic. Fred Smith, on the other hand, states that the great majority of horses are slightly myopic. All are agreed that the majority of horses are astigmatic, with the horizontal meridian the less curved and so the less refractile. A slight degree of astigmatism in this direction may be said to be physiological in the horse.

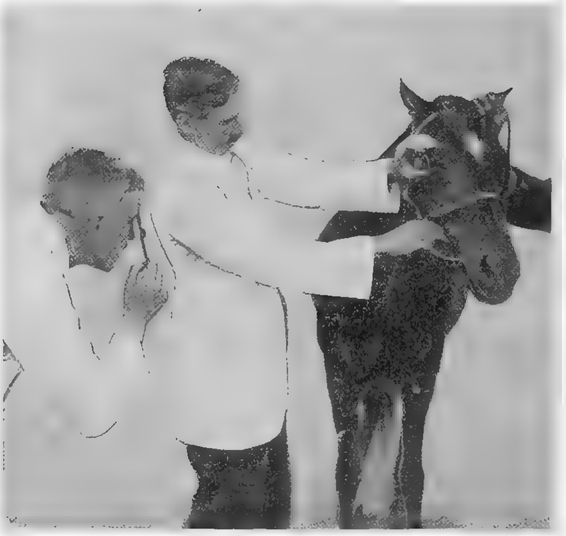

FIG. 173.—Retinoscopic examination.

Myopia or hypermetropia of anything over 1 diopter is serious in that it causes blurred vision, and is commonly held to be associated with shying.

Lang and Barrett,[1] in an investigation on the "Refractive Character of the Eyes of Mammalia," found the cow to be commonly hypermetropic and often astigmatic; dogs and cats to be practically emmetropic; and most wild animals to be hypermetropic.

Myopia, or *short-sightedness*, is the condition in which the rays of light entering the eye are brought to a focus not on the retina but in front of it. It is most commonly due to an excessive length of the eyeball from front to back, although other causes, such as excessive curvature of the cornea or of the lens, may be responsible for the condition. The myopia can be corrected by placing a suitable concave lens in front of the eye.

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[1] *Royal London Ophthalmic Hospital Reports*, vol. xi. part 2.

Hypermetropia, or *long sight,* is the condition in which the rays of light entering the eye are brought to a focus behind the retina. It is most commonly due to shortness of the eyeball from front to back, but may be due to flattening of the cornea or to absence of the lens due to dislocation or after cataract extraction. It can be corrected by placing a suitable convex lens in front of the eye.

Astigmatism is that condition in which the refracting surfaces of the eye (cornea and lens) are not spherical but are curved irregularly. As a result, the rays of light passing through one meridian of the eye are not brought to a focus at the same point as those passing in through another meridian. The cause is usually due to uneven curvature of the cornea, and in "regular" astigmatism the directions of greatest and least curvature are at right angles to one another and lie in the vertical and horizontal meridians respectively. This is the common condition in the horse, and it is a congenital one.

Catoptric Test.—This is a test which is sometimes used for the detection of opaque specks in the cornea or lens. If a taper or candle is held in front of the eye there will be seen three images of the flame on looking into the eye. These are formed on the catoptric (or reflecting) surfaces of the eye, namely, the surface of the cornea, the anterior surface of the lens, and the posterior surface of the lens. The first and second images are upright, the one from the cornea being the larger and more distinct. The third image is the smallest and is inverted. When the light is moved the first and second images move in the same direction as the light, but the third inverted image moves in the opposite direction. If the reflecting surfaces are normal, and the media (cornea, aqueous humour, and lens substance) clear, the images are sharp and distinct. Opacities intercept the rays of light and prevent any reflection, so that in case of a diffuse cataract no third image will be visible, and if the anterior capsule of the lens is thickened and opaque the second image may be more or less blurred. Specks in the cornea or lens interfere with the momentary images as the light passes across. The test is useful in some cases, but ability to use the ophthalmoscope provides a method giving more information and of greater reliability.

Anæsthesia for Eye Operations

Anæsthesia of the Lids.—Where operative procedure is to be limited to the lids, in the majority of cases it will be found that local anæsthesia is all that is necessary; and, provided that care is used in the method, little or no restraint will be needed. A few drops of a 5 per cent solution of cocaine hydrochloride with adrenalin 1 in 2000 should be instilled into the subconjunctival sac every couple of minutes for a quarter of an hour. This will give satisfactory anæsthesia, though somewhat limited in extent, in the lids themselves. In case it may be found necessary to extend the field after the operation has been commenced, it is usually best to strengthen the conjunctival anæsthesia by a subconjunctival injection near the canthi of the lids and an intradermal or hypodermic injection on the skin surface of the lids, using a 1 per cent solution in both cases, keeping in mind that for the upper lid the sensory nerves are derived from the ophthalmic, and for the lower lid from the maxillary, division of the fifth cranial nerve.

In dogs, if not otherwise contra-indicated, such anæsthesia of the lids may be preceded by an injection of morphine half an hour before operation.

Anæsthesia of the Globe.—In all operations on the globe, on the other hand, owing to the inability to obtain co-operation on the part of the patient, general anæsthesia is usually preferable on account of the danger of movement and to allow of more careful manipulation and finer work. In the human subject the whole globe of the eye can be anæsthetized by means of local applications for most of the surgical procedures, and the same methods can be adapted for use in animals for such interference as examination, and removal of foreign bodies. Of local anæsthetics, *cocaine hydrochloride* is the best drug, and though more toxic generally has not the same irritating action on the conjunctiva, and is more reliable than novocaine. The 5 per cent solution, together with adrenalin 1 in 2000, is a useful strength for instillation into the conjunctival sac, the drops being applied by soaking a small piece of cotton-wool in the solution and expressing the drops required into the exposed conjunctiva.

This should be done every few minutes for a quarter of an hour, when the eye will be found to be anæsthetized. Atropin 1 per cent can be added if it is desired to dilate the pupil at the same time. Many workers, in addition, supplement this by a subconjunctival injection near the globe of a 1 per cent cocaine solution. It may be necessary if the condition demands interference with the external eye structures, and possibly prolongs the period of anæsthesia.

In dogs the use of strong solution of cocaine, such as the 10 per cent, is not recommended for instillation as toxic effects from absorption may result. The symptoms are salivation, increased respiratory movements, excitement and hyperæsthesia, and clonic spasms. The amount injected into the tissues should be regulated not to exceed one grain for a dog of the fox-terrier size.[1] Some dogs appear to show a special idiosyncrasy in respect of this drug.

Of the substitutes for cocaine, those most commonly used are novocaine, β-eucaine, and holocaine. Novocaine may be used in 2 to 5 per cent solution in water ; β-eucaine and holocaine similarly. All three are soluble in water, and the solutions may be sterilized by boiling.

General anæsthesia is induced in the larger animals by the use of chloroform ; in the dog with chloroform, A.C.E. mixture, or ether—in each case with the usual precautions.

II. Diseases of the Eyelids

The skin of the eyelids is subject to various skin diseases similar to those on other parts of the body and requiring similar methods of treatment. Some of these conditions are of importance to the ophthalmic surgeon because any irritation set up by disease of the lids may extend to the conjunctiva or to the eye itself, or may cause rubbing and scratching on the part of the patient, with consequent damage to the eye.

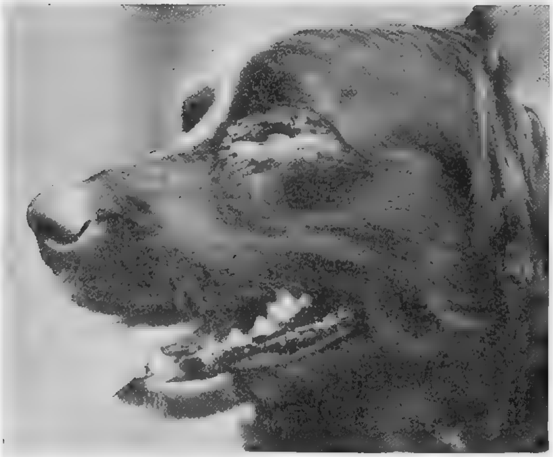

FIG. 174.—Eczema of eyelids.

Parasitic skin diseases, such as *mange* in the dog and cat, and *ringworm* in the calf and less often the foal, affect the skin of the eyelids.

Eczema of the eyelids may be part of a general eczema about the head, or it may be an irritation of the skin due to discharge from the conjunctiva, or due to a flow of tears over the lid margin (epiphora), or to the frequent use of some eye lotion, especially atropine (Fig. 174).

Treatment.—The parasitic affections must be treated in accordance with their own special requirements, always remembering that any untreated irritation of the lids is likely to lead to damage to or infection of the eye by reason of the rubbing or scratching caused. *Eczema* will also require to be treated on general lines, but if due to epiphora or conjunctival discharge a little vaseline or zinc ointment smeared on the lids will protect the skin. If there is irritation, an ointment of sulphur, oil of tar, and lard will often relieve the condition, whilst painting with orthoform in glycerine or in collodion (1 in 16) will anæsthetize the part for several hours.

Blepharitis.—Blepharitis is the name given to an inflammatory condition of the lid margins, which may be differentiated into two forms according to degree, namely, superficial and deep or ulcerative. The condition is really an eczema of the parts.

It may appear in dogs and cats from irritation resulting from parasitic infection, or much more commonly from the irritation of some purulent discharge from the conjunctiva, especially in distemper.

In the ulcerative form the condition tends to be more severe, with destruction of the lash follicles by follicular suppuration. In both forms there is a gumming of the lids and matting of the lashes.

Treatment consists in the application of ointments to the lid margins, a useful one being the ung. hydrag. flav. (10 grs. to 1 oz.), together with antiseptic eye-washes for the relief of any conjunctivitis present. The scabs and crusts should be removed by softening first with olive oil and then bathing with boracic acid lotion. The conjunctiva and cornea must both be watched for any signs of infection or ulceration.

Hordeolum, commonly called "Stye," is a localized suppuration in the follicle of an eyelash. It is a rather painful condition and leads to some œdema and general inflammatory swelling of the lid in its neighbourhood. Very often there is a succession of styes.

Treatment.—The process may often be aborted by plucking out the affected hairs. As the small abscesses form they should be evacuated.

Chalazion, or *tarsal cyst,* may be a retention cyst or possibly a granulomatous condition of a Meibomian gland. It appears as a tumour, from the size of a barley-grain to a hazel-nut, in the thickness of the lid, hard and painless, the conjunctival surface over it looking rather pale from pressure. The contents are pasty and viscid.

Treatment.—The tumour can only be got rid of by operation. It is best evacuated by an incision from the conjunctival surface after anæsthetization of the part. After opening the sac its wall is scraped with a small curette and the conjunctival sac washed out with boracic acid lotion.

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[1] A safe rule is not to exceed $\frac{1}{10}$-grain for each 1 lb. body-weight.

Œdema of the Lids.—Œdema of the lids may be due to some systemic disturbance, as acute kidney condition, or may be part of the symptoms in the final stages of cardiac failure, though in animals it is not common to find these processes in operation.

In the horse it is much more often seen in association with general or local septic conditions, and it may be present bilaterally as part of the œdema of the face in purpura hæmorrhagica, in influenza, or in the marked œdema which follows the intense inflammatory swelling of some retropharyngeal infection. In the unilateral form it is generally the result of some local septic condition of the lids or conjunctiva or globe, often following a wound.

When limited to one eyelid it is usually the upper lid that is affected, and it may give rise to the impression that some proptosis is also present.

In some districts the attacks of biting flies produce a similar swelling.

Treatment consists, apart from the measures directed to the relief of any general or local septic condition, in the application of hot-packs and antiseptic eye-washes. In cases of pharyngeal swelling, where the œdema is intense with exposure of the conjunctiva and ulceration, puncturing the lids and insertion of drainage-silk may give relief. As a protection from flies, leather fringes may be worn while the animal is working.

Ankyloblepharon is a condition following blepharitis, or burns or other injuries, in which the margins of the upper and lower lids become either partially or completely united as a result of healing of the opposing raw surfaces.

Symblepharon, or union of the bulbar conjunctiva with that of the lids, may occur at the same time. Here also burns, injuries, and ulcers are the usual causes. The treatment is operative and consists in dividing the united parts, and then preventing reunion by interposing flaps of healthy conjunctiva on the raw surfaces.[1]

Lagophthalmos, or inability to close the eye, may be due to paralysis of the orbicularis oculi muscle following injury to a portion or trunk of the seventh cranial nerve, or, on the other hand, it may be due to an inability of the eyelids to approximate owing to tumour within the orbit or excessive granulation process following trauma of the globe.

The danger to the eye lies in the exposure of the cornea, with drying of its surface and absence of the clearing action of the lids, this soon producing a keratitis and ulceration. In paralytic cases there is usually present some amount of movement in the globe itself due to the action of the eye muscles, which reduces the severity of the exposure and accounts for the small amount of damage to the cornea in some of these cases.

In cases where the lagophthalmos is due to the presence of tumour, removal of the latter, especially those on the membrane, will remedy the condition, and it is common experience that a markedly opaque ulcerated cornea clears up rapidly once the tumour is removed if the damage to the cornea is not of long standing.

In paralytic cases the cornea should be protected by suturing the lids together, the stitches going no deeper than the skin. Strapping with adhesive plaster gives similar protection and has the advantage of allowing regular inspection as to the state of the cornea.

This protection should be afforded until the restoration of the nerve function is observed by movements of the lids. Where the condition is due to a staphyloma it should be treated accordingly.

In many cases of bilateral seventh nerve injury, such as occurs when a horse strikes the occiput on the roof of a truck or door, though the muscles of the nose and mouth are paralysed the fibres to the orbicularis oculi escape injury.

Ptosis.—Ptosis, or inability to raise the upper lid, is usually an acquired disease in animals, and even then is rare. The drooping of the lid is due to a paralysis of the levator palpebræ muscle supplied by the third cranial nerve, or to a temporary injury to the lid itself producing œdema and immobility.

In injuries, the ptosis disappears with the improvement in the state of the lid, while in persistent paralysed conditions it may be necessary to split the lid and join the tendon of the affected muscle either to the fibres of the frontalis or to those of the superior rectus.

Trichiasis, or turning-in of the eyelashes, may be present as a complication of entropon but may occur apart from the latter condition. Trichiasis is brought about by chronic conjunctivitis causing distortion of the eyelid, or by chronic blepharitis. It sooner or later leads to a keratitis through irritation of the cornea, with pain, lachrymation, opacity, and possibly ulceration.

Very often only a group of lashes growing close together in a distorted fashion may be inverted instead of the whole row.

Treatment.—Plucking out the lashes will give temporary relief, but it is usually more satisfactory to remove the follicles of the offending hairs. Two parallel incisions are made along the margin of the lid, one on each side of the ciliary row to the extent of the inverted lashes. The incisions are continued to a sufficient depth to ensure the complete removal of the follicles.

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[1] See treatment of Conjunctivitis.

When the whole row of lashes is affected, the removal of an elliptical piece of skin from the affected lid, as recommended in cases of entropion, may give a satisfactory result.

Entropion, or turning-in of the eyelid, may affect one or both eyes simultaneously. Trichiasis is also usually present. The effect on the cornea is always serious, and is due to the irritation of the lashes and rough edges of the lids. A keratitis results, with possibly corneal ulcer, which may go on to staphyloma or rupture of the anterior chamber. A conjunctivitis is always present and soon glues the lids with a purulent discharge.

The condition may be congenital or acquired, the former condition being often seen in puppies, in which case it may affect all the puppies of a litter. The bilateral form is commonest in dogs, and when acquired seems to be preceded by a catarrhal conjunctivitis of low grade, the chronic thickening and contraction of the conjunctiva shortening the palpebral aperture and inverting the lids. As a senile change it is not common in animals.

In dogs there is certainly some evidence of a tendency for the disease to run in families, and there is also a well-marked predisposition in some breeds, particularly Pomeranians, Chows, and Poodles, to the complaint.

Once the lids are inverted by structural change operation is necessary and should be done as soon as possible to relieve the irritation on the cornea. At the same time it must be remembered that spasm of the orbicularis muscle (blepharospasm) due to any irritation in the conjunctiva causes a turning-in of the lids which simulates structural entropion. Treatment of the conjunctivitis and removal of the irritation relieve the spasm without operation.

A preliminary treatment for clearing up the infection should be carried out for a few days prior to any operative interference, the conjunctival sac being irrigated twice daily with a solution of perchloride of mercury 1 in 10,000, and the lids being dressed with ung. hydrag. flav. 2 per cent, after any long hair has been removed.

Treatment.—For the condition in young dogs and in the congenital form where shortness of the palpebral tissue is marked, the operation of canthotomy or canthoplasty appears to give excellent results.

Canthotomy consists in simply enlarging the palpebral aperture at the external canthus. A pair of straight blunt-pointed scissors are introduced at the outer commissure and the skin and conjunctiva divided to the required distance, the length of the skin incision being a little greater than that in the conjunctiva.

In *canthoplasty* the operation consists of, in addition to the incision described, a suturing of the severed conjunctiva to the skin in order to ensure union of mucous membrane to skin and not to bulbar conjunctiva. The suture in the angle of the newly-formed canthus should be put in first, and after that as many stitches as are required may be inserted in upper and lower lid margins.

In other forms of entropion, where the inversion is not due simply to narrowness of the fissure, there is a choice of a number of operations for everting the inturned lids.

The simplest method, and one which is almost uniformly effective in the dog, consists in the removal of an elliptical piece of skin from the affected lid, the long axis of the ellipse being parallel to the lid margin. This may be done by catching up a piece of skin in forceps and removing the desired amount with a pair of slightly-curved scissors. The size of the opening thus made will have to be regulated by the amount necessary to retract the eyelid when the edges of the wound are brought together by sutures.

As a preliminary, the hair is removed from the skin of the lid with scissors and the skin is painted with tincture of iodine. Local anaesthesia is induced by means of cocaine and adrenalin injection. The piece removed may include a strip of the orbicularis muscle, but the conjunctiva lining the lid must not be included. After suturing, the wound may be painted with iodoform and collodion as a protective dressing.

It is usually necessary to treat both lids, and one may also find it of advantage to combine this method with canthotomy or canthoplasty.

For animals the above procedure appears to be all that is necessary, but in the human subject the procedures are directed more towards the alteration in shape of the tarsal cartilage or in the position of the cilia.

Ectropion.—This is a condition in which the eyelid is everted, the conjunctiva being exposed. Though in some breeds of dogs, notably bloodhounds and St. Bernards, the condition is normally present to a mild degree, as a pathological condition it is not common. When seen the condition is almost always confined to the lower lid, and is usually classified according to its etiology into muscular, cicatricial, or paralytic.

The muscular type is a senile change not seen in animals. The cicatricial variety is the form usually met with, and it arises from incorrect apposition of the edges in the healing of a wound or tear of the eyelid. There is often an epiphora with scalding of the face from the overflow of tears.

Treatment consists of operative measures directed towards tightening up or elevating the drooping lower lid.

If due to cicatricial deformity, the scar may be excised and the skin of the lids thus shortened may be brought into correct apposition and sutured, the conjunctiva being treated in a similar manner. Another method, which gives good results when the skin of the lower lid is too long, is to excise a triangular piece of the whole thickness of the eyelid. This V-shaped piece has its base at the lid margin, and it is well to remove a wider area of the conjunctiva and tarsus than of the skin. The edges of the conjunctival wound are united with three or four sutures put in very securely to avoid a premature giving way. The frequent use of a little boracic ointment inside the lid lessens the irritation of the eyeball by the sutures. The skin wound, including the orbicularis, is also closely sutured, and a collodion dressing applied.

Wounds and Injuries.—Tears of the lids are the commonest form of injury, the lower lid being the more frequently involved. In the horse, catching the lid on a hook or nail in the stall or on barbed wire in a fence are common causes. More rarely parts of the harness or winkers may be the offending objects. In dogs, bites and scratches are frequently to blame. More extensive injuries to the lids, either one or both, may be caused by a kick over the orbit, with fracture of some part of the bony processes and serious contusion of the soft parts. Marked œdema of the lids may be present simulating proptosis, and there may be injury to the globe of the eye itself.

Treatment of the lid injuries themselves will depend to a great extent upon the degree and position of the lesion. Injuries confined to either the skin or conjunctiva of the lids may be sutured with confidence, the material being preferably fine silk for the conjunctiva and fine silkworm-gut for the skin. On the other hand, tears involving the whole thickness of the lids, especially when across the fibres of the orbicularis oculi, seldom give satisfaction when sutured, the continual strain of movement causing the sutures to cut out in a great number of cases. The lower lid, however, is the more amenable to treatment by suture on account of its lesser mobility, and, for the same reason, plastic operations for the repair by means of a flap of skin of some defect due to destruction of the lid by injury, or after operative removal for malignant growth, are much more hopeful in the lower than in the upper lid.

Because of the frequent dragging out of ordinary sutures, pin sutures are often recommended for wounds of the eyelids in the horse. The pins are inserted about half an inch apart, taking a fairly deep hold of the skin edges. A piece of fine silk is then wound in a figure of eight pattern round each pin, or continuously from one pin to the next in series, and tied. The points of the pins are then cut off with pliers. These sutures give considerable support to the wound edges and lessen the mobility of the part, so favouring union.

After this or any other operation on the eyelids in the horse it is unwise to allow the animal to be loose in a box or to be tied in a stall in the ordinary way. The horse should be put on pillar-reins of such a length that he is unable to rub the wound.

As the result of injury to the lower lid it occasionally happens that epiphora results, the lachrymal discharge escaping through the rent. In these cases it will often be found expedient to dissect the conjunctiva from the lid on each side of the tear and suture this layer separately with fine silk, and to bring up a flap of skin from the face to fill the gap in the lid. In other cases where there is a simple rent without loss of tissue suturing may be successful if a small drainage-tube is inserted at the bottom of the wound to carry away the tears and thus prevent maceration of the edges until healing of the upper part of the wound has taken place.

Not infrequently a large part of the lower lid may be removed without much remaining deformity, and though tightening of the lid may result, with shortening of the palpebral aperture, a very serviceable eye remains.

Tumours involving the Lids.—The nasal portion of the lower lid and the nasal canthus are the external parts most early involved in the extension of an epithelioma of the membrana, and these parts if infiltrated should be freely excised when the membrana is removed. It must be remembered that the dangerous spot is that point where the fibres of the orbicularis are inserted to the lachrymal tubercle, and the neighbourhood of the ducts, for when recurrence takes place after operation it is usually at this site.

The removal of the puncta and ducts in the operation causes some overflow of tears, but in most cases the discharge soon ceases either due to the restoration of the continuity of the ducts or to loss of the aspirating effect of the lachrymal sac.

The effect on the lower lid of such an operation is usually one of decreased mobility, with reduction in size of the palpebral aperture, but the function of the eye is usually in no way impaired.

A granulomatous condition of the caruncle, membrana, and lower lid due to the presence of parasitic embryos of the *Habronema* species may be easily mistaken for tumour growth, but should be distinguished from it by the presence of small necrotic areas about the size of a pin's head, within or immediately below the mucous layer of the surrounding conjunctiva.[1]

III. Diseases of the Membrana Nictitans

The "*winking membrane*" or third eyelid serves as an extra protection for the globe of the eye, and by its sharp "flicking" movement across the eye it removes any foreign particles from the front of the globe. It consists of a semi-lunar plate of hyaline cartilage covered on its free anterior and posterior surfaces with conjunctiva. There are numerous nodules of lymphoid tissue in the membrana, and on its deep face are the openings of a small gland, the Harderian gland, something like the lachrymal gland in structure which secretes a lubricating fluid. When the retractor muscle of the eyeball contracts, the membrana is protruded and shoots across the eye, clearing its surface.

The membrana is subject to various diseased conditions in the different animals. The conjunctival covering is frequently involved in conjunctivitis (*q.v.*), especially of the follicular type. Various tumours, notably papilloma and, more common and more serious, epithelioma, frequently originate from the epithelium covering the membrana, especially in horses and cattle.[2]

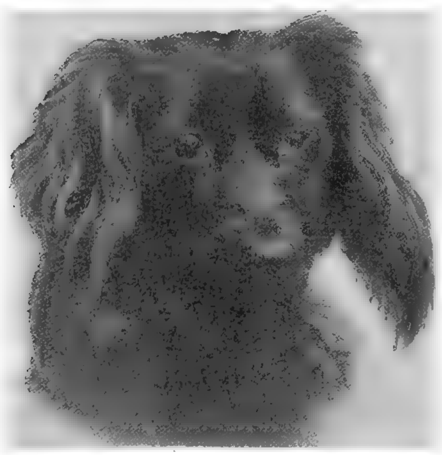

FIG. 175.—Cyst of the membrana.

Whenever the membrana is found to be the point of origin of a tumour the whole structure should be amputated without loss of time.

Cyst of the Membrana.—Sometimes there is in the dog or cat a small swelling in the substance of the membrana, which is smooth and covered with conjunctiva, firm, painless, and only objectionable because of its conspicuous position as it protrudes at the inner canthus. The nodule is the result of obstruction or hypertrophy of the Harderian gland and the condition is often bilateral (Fig. 175). Because of its unsightliness, the best treatment is to snip off the portion of the membrana in which the nodule occurs with scissors.

Paralysis of the membrana occurs commonly in the dog and cat as the result of some debilitating disease, especially distemper. The animal is brought for treatment because of a "film over the eyes," for both are usually affected, and it is found that the two membranes are protruded half-way or more across the eye. Usually the animal looks anæmic and is in a weak state, and the history of a recent attack of distemper is common.

Treatment.—With improvement in the general health the condition generally rights itself. The prescribing of tonics, such as arsenic, strychnine, or iron, and advice as to food, exercise, and general management form the proper course to adopt. The client should be informed that the condition often takes weeks or months to return to normal, but that it will eventually do so. Not infrequently such a prognosis is unpalatable to the owner. A cure is desired at once. In such cases amputation of the offending membrana may be practised without any noticeable harm to the eye. Sometimes indeed the operation has to be advised by the surgeon because the membrana is so far protruded as to interfere with sight and seriously to affect the cornea. To amputate the membrana it is only necessary to seize it with fixation forceps, draw it well forward, and excise it with a strong and sharp pair of curved scissors.

IV. Diseases of the Lachrymal Apparatus

The lachrymal apparatus comprises (1) the *lachrymal gland*, situated within the orbit beneath the supra-orbital process. It secretes the clear lachrymal fluid or tears. (2) *The excretory ducts* of the gland opening into the dorso-lateral part of the conjunctival sac near the superior conjunctival fornix. (3) The *puncta lachrymalia*, the entrance to the lachrymal ducts, one on each lid near the internal canthus. They are fine, slit-like openings in the horse, and pin-hole in shape in the dog. The puncta are normally in contact with the globe at the conjunctival reflection and occupy positions above and below the *lacus lachrymalis* respectively. From the point of view of drainage the lower punctum is the more important, as most of the lachrymal fluid leaves by this route. (4) *The lachrymal ducts* or canaliculi, two in number, extend from each punctum to the lachrymal sac, either entering separately or, as is more common, fusing after convergence before entry. The ducts are lined by stratified epithelium. (5) *The lachrymal sac* is the dilated origin of the naso-lachrymal duct, and occupies the funnel-shaped portion of the lachrymal bone known as the fossa of the lachrymal sac. It is continued by (6) *the naso-lachrymal duct*, which makes its exit along a bony canal through the outer wall of the sinuses and nasal cavity. The naso-lachrymal duct opens on the floor of the nostril in the horse, near the junction of the skin with the nasal mucous membrane, by an oval opening which can be seen on inspection of the nostril. In the horse the upper part of the duct is about 8 mm. in diameter, at about its middle the diameter is reduced to 3 or 4 mm. and then widens near its terminations. Valve-like folds of mucous membrane are often present which, together with the construction at the isthmus, tend to make the passing of a probe a matter of difficulty. In the dog the naso-lachrymal duct usually opens on the lateral wall of the nostril below the inferior turbinal.

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[1] See "Tumours of the Eye," p. 774.

[2] See *Ibid.* p. 776.

The functions of the lachrymal apparatus may be interfered with as the result of injuries to the orbit or bones of the face, or of such injuries of the skull as involve nerves supplying the ocular structures. The lachrymal gland may be injured in fracture of the supra-orbital process of the frontal bone or may be involved in consequent sepsis if the fracture is compound.

Otherwise *the lachrymal gland* is practically never diseased. Excessive or continuous lachrymation is often seen, and should lead to a careful inspection of the cornea or conjunctiva for the presence of a foreign body.

Epiphora, literally a flow of tears, is the name given to an overflow of tears which, unable to escape in the ordinary way, come over the lid margin and trickle down the face. The continuous flow of tears over the skin soon causes it to become bare and eventually inflamed and even ulcerated. Epiphora is the commonest sign of abnormality in some part of the lachrymal apparatus, puncta, canaliculi, sac, or nasal duct. Apart from the unsightly appearance and the scalding of the skin of the face, epiphora merits attention because the underlying cause is often some disease with more important effects on other structures. Moreover, lachrymation is usually excessive. *Malposition of one or other punctum*, usually the lower one, is a common cause of epiphora. This may often be brought about by inversion (entropion) or eversion (ectropion) of the eyelids. In some cases there is *stenosis or even occlusion of the punctum* as the result of catarrhal conjunctivitis or blepharitis, or because of tumour of the caruncle or due to the presence of a foreign body. Congenital atresia of the puncta has been recorded in the foal.

Fracture of the bony orbit involving the sinuses usually presents a line of cleavage through the fossa of the lachrymal sac with injury to the latter structure, producing a temporary or permanent obstruction.

Treatment.—With the repair of entropion or ectropion the overflow of tears may cease. Where injury to the lids has been followed by healing in which the lower punctum is not replaced in its normal position on the globe, and epiphora has resulted, a plastic operation such as one of those recommended for entropion can be adopted.

In a large number of cases following injury complete restoration of continuity of the passage occurs, provided that no infection of the ducts persists after healing of the surrounding parts is completed.

Treatment in traumatic cases is usually in the direction of reduction of the deformity of damaged bones and removal of any fragments. Sepsis, of course, is treated on general lines. Stenosis of the puncta or canaliculi is treated by slitting open the lower punctum and canal by means of a special probe-pointed knife—Weber's knife. The probe point is inserted through the punctum into the canal and then the cutting edge is turned so that in cutting out the blade will open up the canal and make a slit on the lid margin inclined towards the eye, so that tears readily gravitate into it or are aspirated into it by the eye movements. The wound edges must be kept open by means of a probe for a few days, after which they show no tendency to unite.

The *caruncle* may be swollen as the result of chronic inflammation in adjacent structures, it may become hypertrophied, or it may be the starting-point of a tumour. Benign tumours sometimes affect the caruncle, but more commonly it is the site of sarcoma or epithelioma. An enlarged caruncle often obstructs the ducts.

Treatment.—For a chronic swelling or hypertrophy of the caruncle it is best to snip off the whole structure with scissors or apply a ligature so that it will slough in a few days. If malignant disease is suspected then early removal of the growth is the only remedy. Neighbouring structures are involved early as a rule, and a serious operation is usually necessary in order to remove all traces of the infiltrating growth.

Dacryo-cystitis, or inflammation of the lachrymal sac, is a rare condition in animals. It may be caused by chronic catarrh of the lachrymo-nasal duct or structure of the duct with consequent distension of the lachrymal sac. The retained secretion favours infection, and so usually a chronic dacryo-cystitis is set up. Sometimes pyogenic organisms gain an entrance and acute dacryo-cystitis with abscess formation occurs. Sometimes the lachrymal sac is involved in an injury to the bone by means of a blow. If there is a wound the sac may be opened and a lachrymal fistula opening on to the face may remain when the rest is healed. Following this infection of the sac may easily occur.

Symptoms.—There is a swelling which may or may not be painful, just internal to the inner canthus. Pressure over this may cause the sac contents, a catarrhal exudate or actual pus, to escape from the puncta into the conjunctiva. With suppuration the swelling may point and open near the inner canthus. Epiphora is present because of the obstruction.

Treatment.—The best procedure is to extirpate the sac completely, if possible without opening it. An incision is made in the skin over the swelling, and the sac thus exposed is carefully dissected from its attachments and removed. If the sac is opened during removal, or in the case of an inflamed sac with a fistula, or one in which an abscess has formed and been evacuated, the walls should be curetted, and then disinfected with some reliable agent such as tincture of iodine or strong silver nitrate solution. Sometimes the attempt is made to produce a fistula from the sac through the lachrymal bone into the nose, and this, by reason of efficient drainage, usually brings about an improvement.

After extirpation of the lachrymal sac for any reason the flow of tears over the face is not very serious, providing that the inflammatory conditions in the adjacent structures are cured at the same time.

Obstruction of the Nasal Duct.—This is one of the commonest causes of epiphora. The closure of the duct may only be temporary as a result of nasal or conjunctival catarrh, or a permanent occlusion may occur from the same cause. The temporary obstruction is sometimes made permanent by rough and too frequent use of the probe. Another cause of obstruction is a malignant growth of the caruncle or other parts in the neighbourhood, with extension to the lachrymal sac or the bone. With the removal of a tumour, the parts may be so damaged that scar tissue obstructs the duct, and the same happens when the lachrymal sac is extirpated. The one constant sign is epiphora.

Treatment.—When the duct has been cut across or destroyed at its origin by some operation the condition is irremediable. A temporary obstruction due to catarrh is best treated in the horse by means of frequent injections of normal saline solution through the lower opening of the duct in the nostril. In the dog this cannot be done, since the nasal orifice is out of sight. In this case a fine bougie or silver-wire probe must be passed from above, if necessary, after slitting up the lower canaliculis. If this is impossible, and the epiphora troublesome, a fistula must be made through the lachrymal bone into the nose.

Tumours originating in the structures of the lachrymal apparatus are rare. Adenomata and malignant growths of the lachrymal gland have been recorded, but the treatment calls for no special mention here apart from the fact that the whole of the lachrymal gland can be removed without fear of exposing the eye to any serious harm.

In nearly all other cases tumours are due to a direct extension of malignant growths of neighbouring parts.[1]

In removal of the globe in cases of epithelioma one should be careful to see that the lachrymal gland is removed, as well as the soft structures at the medial canthus, for when recurrence takes place after removal of a tumour it will be found in nearly all cases to be in the vicinity of the lachrymal sac.

V. Diseases of the Conjunctiva

The conjunctiva is the membrane which lines the inside of the eyelids (palpebral portion), covers both free surfaces of the *membrana nictitans* or third eyelid, and spreads over on to the globe of the eye (bulbar portion). The deepest part of the conjunctival sac, where the palpebral conjunctiva is reflected on to the bulbar portion, is known as the *sulcus*, or the upper, and lower, *fornix*. Close to the free margin of the eyelids the membrane is bound tightly down to the underlying dense fibrous layer of the eyelid known as the *tarsus*. Here the epithelium consists of a double layer of cuboidal cells. Behind the tarsus the epithelium is thicker and more loosely held so as to allow greater freedom of movement. The underlying tissue is very vascular and consists of loose lymphadenoid tissue. The epithelium of the bulbar conjunctiva is still thicker and of the pavement variety, being bound down to the sclera by means of a thin layer of elastic tissue. At the margin of the cornea the conjunctiva slightly overlaps the cornea, this rim being known as the limbus. Here the conjunctival epithelium becomes similar to, and merges with, that of the cornea, having a deep layer of columnar cells, middle layer of cuboidal, and surface layer of flattened cells more or less horny. The blood supply of the conjunctiva is twofold, the posterior conjunctival vessels being derived from the palpebral branches of the ophthalmic artery, whilst in the region of the limbus are very fine twigs passing back from the anterior ciliary vessels. In most cases of conjunctivitis the former alone are congested, whereas ciliary congestion is a characteristic feature of inflammatory conditions of the iris and cornea.

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[1] See "Tumours of the Eye," p. 774.

Conjunctivitis. Inflammation of the Conjunctiva.—This is one of the commonest affections of the eye in all animals. It may be caused by any injury to the part, including infection by bacteria, and even where bacterial infection does not initiate the process it is extremely likely to follow and aggravate any injury. On the normal conjunctiva a considerable variety of micro-organisms may be found in small numbers, and with any damage to the epithelium, whether by trauma, dust, infection by flies, chemical agents, or other means, there is exudation from the membrane which predisposes to the multiplication of the bacteria. The bacteria invading the conjunctiva may be, and usually are, non-pathogenic, as is the case with many air-borne organisms to be found on the normal conjunctiva. They may, however, be pathogenic, and of these some can attack the uninjured and unbroken membrane, as, for example, the *gonococcus* in man, whilst others only attack the abraded or injured membrane, for example, the *tubercle bacillus* and *staphylococcus.*

Clinically, conjunctivitis shows a variety of types, such as catarrhal, purulent, croupous, follicular, and others, but these cannot be correlated with specific bacteria, for different organisms may produce the same type of case, whilst the same organism may be present in quite different clinical types. Conjunctivitis evidenced by marked congestion and more or less discharge, often muco-purulent, is a common accompaniment of many acute infective diseases, such as catarrhal fever and influenza of the horse, malignant catarrh, and rinderpest of cattle, sheep-pox, and distemper of the dog. In all these and similar cases the conjunctivitis is simply a complication of a general disease in which catarrh of mucous membranes is a marked feature. The conjunctivitis is, as a rule, overshadowed by the general symptoms of the disease, but it may be serious, resulting in permanent defects in the eye. Especially is this so in cases of distemper in the dog and cat. Injection of the conjunctiva and lachrymation are early symptoms, but a muco-purulent discharge soon makes its appearance, and if the condition is neglected the cornea soon becomes implicated. Opacity of the cornea occurs in many cases; not infrequently ulceration and staphyloma follow, so that any neglect is likely to be attended with disastrous consequences. The treatment follows the lines to be advised for purulent conjunctivitis, but constitutional treatment, especially during convalescence from the underlying general disease, is also called for.

Acute Catarrhal Conjunctivitis.—*Causes.*—Simple conjunctivitis may be brought about by a great variety of irritants, such as dust, particularly of certain soils; seeds, and the pollen of flowers; chemical irritants such as lime, or irritant gases in badly ventilated stables; flies and other insects; sharp pieces of chaff, or barley or oat husks; wounds and scratches caused by stubble, rough grass, or bushes; wire; and bites and scratches inflicted by another animal.

Whatever the original irritant, with the accumulation of the products of inflammation, bacteria of various kinds, air-borne, and impinging on the conjunctiva, find suitable conditions and multiply. They may or may not be pathogenic, but often the ordinary pyogenic *staphylococci* and *streptococci* are among them. Out in the open there is little opportunity for bacterial infection to spread from eye to eye, and from one animal to another, but in animals stabled, groomed, frequently handled, and wearing halters or bridles, there is great chance of spread of infection. Even at pasture enzoötics of conjunctivitis do sometimes occur in herbivora.

Symptoms.—The first sign of conjunctivitis is often simply a flow of tears over the eyelid and down the face of the animal. The eyelids are partially closed and the animal may try to avoid light, though this is not a marked feature in a simple case. On closer inspection the conjunctiva is much congested, bright red in colour, especially in the depth of the sac towards the fornix, and angry-looking as compared with the normal pale rose-pink colour. This redness, indicating hyperæmia, may be widespread over the whole membrane, or more or less localized to the seat of injury or to a particular part of the membrane. Thus the tarsal conjunctiva may be especially affected, or the bulbar, or the palpebral, with special characters in each case. The eyelids themselves often appear swollen or puffy, and they may be distinctly hot. Sometimes the conjunctiva may be swollen, by reason of its infiltration with inflammatory exudate in the subepithelial tissue, and if this swelling is considerable, so as to produce a protrusion of the membrane between the lids, the condition is known as chemosis. In addition to an excessive flow of tears there is a secretion or exudation from the inflamed membrane, consisting of serum and mucus, and in it are shed epithelial cells, leucocytes, and bacteria. Thus even in a slight case there is some discharge, usually sticky in character, so accounting for the dried discharge on the edges of the lids.

Purulent Conjunctivitis.—In some cases the discharge may be very profuse and muco-purulent in character, so producing what may be termed **purulent conjunctivitis.** Such cases are determined by the variety of micro-organisms present. Möller records an epidemic of purulent ophthalmia among dogs in Berlin, in 1883, where the infection was apparently derived from a purulent preputial discharge common in dogs (blennorrhœa), although experimental infection failed to produce the eye disease in healthy dogs.

Enzoötic Conjunctivitis.—In herbivora, especially cattle and sheep, an infectious or enzoötic conjunctivitis may be seen affecting large numbers of animals in a herd or flock. This contagious conjunctivitis has been attributed to a variety of causes, such as irritant pollen or dust from some special soils. It occurs most commonly in summer, spreads rapidly, and is of the purulent type. There is generally some fever, and the cornea often becomes implicated, so that opacity and ulceration are often seen and blindness results in many cases. Several epidemics have been recorded in which the outbreak followed the introduction into a herd of one animal suffering from purulent conjunctivitis (Law), and recovery from one attack has been noticed to confer an apparent immunity (Trombower). Thus the evidence is strongly in favour of a specific bacterial infection as the essential cause. In the human subject cases have been recorded "undoubtedly caused by the hay bacillus (*B. subtilis*). In all of them particles of earth had found their way into the eye."[1] Such an occurrence would provide an easy method of infection in herbivora. In the horse, epidemics of purulent conjunctivitis are also recorded in which the purulent discharge was definitely infective when inoculated into healthy eyes.

Lesions.—In a simple case the structural changes in the conjunctiva consist of dilatation of the blood-vessels and increased vascularity, and an infiltration with inflammatory exudate and with leucocytes in the lymph-adenoid tissue. The epithelial cells proliferate and the surface cells are desquamated, so adding to the discharge.

The conjunctiva lining the tarsal plates may be particularly affected, and in this case, where normally the epithelium is tightly bound down to the tarsus, prolonged inflammation causes a folding or ridging of the membrane with marked leucocytic infiltration in the subepithelial areolar tissue. The epithelium itself may also be considerably thickened. The condition is known as **papillary conjunctivitis.** In chronic cases the granulation tissue in the folds becomes fibrous and eventually horny, showing as irregular, often pedunculated, bodies at the inner edge of the eyelids. In other cases there are nodular accumulations of small round cells in the lymph-adenoid tissue of the retrotarsal conjunctiva, and in that covering the internal surface of the membrana nictitans, producing small lymph bodies or follicles which on eversion of the eyelids project as small, greyish-red millet-seed nodules. This condition is known as **follicular conjunctivitis,** and it is seen fairly commonly in the dog (Fröhner).

Terminations and Complications.—In a simple case with removal of the irritant recovery takes place within a few days. With infiltration and infection of the subepithelial tissue, as in papillary follicular conjunctivitis, the condition is more likely to become chronic. As a result ectropion or entropion with trichiasis may often be brought about. In other cases, especially of the purulent type, there may be infection and consequent infiltration of the cornea leading to opacity and sometimes to ulceration. Chronic follicular conjunctivitis is also liable to be complicated with corneal opacity and pannus (see "Keratitis"). From infection of the cornea the condition may spread to the anterior chamber and so a general ophthalmia be set up.

A further extension of the catarrhal change may reach the lachrymal sac and duct, so causing obstruction of the duct and a flow of tears over the face.

Symblepharon, the term applied to adhesion between the lid and the eyeball, is one of the results of severe membranous conjunctivitis, or a trauma or burn of the conjunctiva. During the healing process there is a great tendency for the bulbar and palpebral surfaces to adhere over a larger or smaller area. The movements of the eyeball are much restricted, and the adhesions, if they extend up to or beyond the corneal margin, may interfere with vision.

Treatment.—The first step is to examine the eye to discover the presence of any foreign body, such as hay-seeds, oat-glumes, or grit. This is by no means an easy matter, but may be greatly helped by the use of a cocaine solution (1 per cent) applied by means of a spray or on a soft camel-hair brush. The foreign body may be embedded more or less in mucus or in the œdematous membrane, and is often difficult to dislodge. A probe, or the corner of a handkerchief, or in the larger animals the handle of a teaspoon may be used for detaching the foreign body.

After extraction, the conjunctival sac must be irrigated with warm boracic acid solution, and in fact a preliminary flushing after cocainization, but before manipulation is commenced, may wash out the irritant agent.

In those cases where some chemical irritant is operating, the application of a few drops of a bland oil such as olive-oil is to be advised, with or without the cocaine spray.

In purulent conjunctivitis the infective discharge tends to accumulate deep down in the conjunctival sac, and it is important to wash out all discharge at each dressing. Frequent irrigation is the essential part of the treatment, and the choice of agent to be used is unimportant as compared with the thoroughness and care exercised. Boracic acid solution 2 per cent (or about 10 grains to 1 ounce of water) is very useful, or perchloride of mercury solution (1 in 10,000) answers very well.

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[1] Swanzy and Werner, *Diseases of the Eye*, 10th edition, p. 50

After irrigation astringent lotions may be used, and zinc sulphate (2 grains to 1 ounce), sodium hyposulphite (10 grains to 1 ounce), or silver nitrate (2 grains to 1 ounce) are recommended. Care must be exercised in instilling these, or any other lotions, into the eye not to damage the eye. With a syringe or any instrument a sharp movement of the animal's head may easily result in injury. It is best to take up the lotion with a little clean cotton-wool, and then, holding this vertically over the eye, to squeeze out the lotion and allow it to trickle in or over the eye.

Meanwhile, care must be taken to avoid infection either of the other eye, if only one is affected, or of other animals. In the case of horses it is best to avoid the use of halters and, unless a shade is required to be fixed and held in position, of headstalls, using instead a neck strap.

The stall or box, and particularly the manger, against which the patient has probably rubbed his eye, are likely to be infective and should not be used for other animals without disinfection. If there is any evidence or likelihood of an enzoötic, healthy animals should be changed on to pasture in some other locality.

It is advisable, and adds much to the comfort of the patient, to darken the box or kennel, and a wet shade in the form of a piece of linen saturated with boracic acid solution, suspended from the headstall, over the eye helps considerably in treatment.

In the more chronic types, such as papillary and follicular conjunctivitis, the application of the silver nitrate pencil to the hard folds or follicles is advisable at intervals of five to six days, whilst if the folliculitis is mainly on the membrana nictitans, as in the dog, the membrane may be removed with advantage.

Whenever the caustic pencil is used it is advisable to neutralize any excess of the silver nitrate which may remain in the sac by flushing with normal saline solution. A harmless silver chloride is formed and the precipitate is removed by the excess of fluid.

Where fever accompanies acute conjunctivitis some general treatment may be called for, such as the use of simple febrifuges, as ammonium acetate, or Epsom or Glauber's salts, in the drinking-water. In the dog a purgative may be given with advantage. The treatment of **symblepharon** is difficult and tedious. One operative procedure is to free the adhesions by dissection, and then lift up two conjunctival flaps adjacent to the raw surfaces. Each flap is cut rather long and narrow and is left attached at one end. By twisting it round on this narrow attached base it is made to cover one of the new raw areas, and sutured into position. The edges of the flap wound are brought together with fine sutures.

Chemical Burns of the Conjunctiva and Cornea.—Probably the commonest agent to cause this injury is quicklime. Freshly lime-washed buildings and stables are often responsible for the production of stomatitis by animals licking the lime-washed parts, and in rubbing the head on such places injury to the eyes is not uncommon.

The degree of injury to the eye varies, but it is wise to assume it serious, for at first sight it will usually appear much less than will be seen to be the case in a few days' time. The conjunctiva may be so damaged that a considerable raw surface will be left when the damaged cells are shed, and symblepharon is likely to result. The corneal epithelium may be so destroyed that although it looks clear at first a permanent opacity will be produced.

Treatment.—For burns by acid substances the appropriate remedy is, of course, an alkaline lotion, such as ½ per cent caustic potash or 2 per cent carbonate of soda. For alkalies a weak acid, such as ½ per cent tartaric acid, is best. The main line of treatment, however, is very thorough irrigation with water, and it is better to proceed with this at once than to waste time finding a chemical antidote. In the case of quicklime or any caustic powder it is important to wash out all particles which may be present, often in the depth of the subconjunctival sac or adherent to the surface of the cornea. A strong solution of sugar in water is very beneficial in the case of quicklime after this preliminary irrigation. The use of cocaine will generally be advisable, and the use of a bland oil, such as olive-oil, gives relief. Frequent irrigations with warm boracic acid lotion should follow.

VI. Diseases of the Cornea

Structure of the Cornea.—The substance of the cornea is made up of a number—forty or more —of lamellæ with fine lymph spaces between them. Each lamella consists of parallel bundles of much fibrillated cells, which have developed from single spindle-shaped connective tissue corpuscles. These latter remain permanently as stellate flattened corpuscles lying between the lamellæ. During development the cornea is provided with numerous blood-vessels, but at and after birth it has no vessels in its substance, but only a looped network of vessels at its periphery. On the front of the cornea an epithelium is bounded inwardly by a structureless basement membrane — Bowman's membrane.

In a similar manner the posterior surface of the cornea is covered by an endothelial layer resting on an elastic layer—Descemet's membrane. Descemet's membrane covers the whole posterior surface of the cornea and at the periphery gives place to the *ligamentum pectinatum*, a loosely woven vascular tissue in the angle of the anterior chamber through which the aqueous humour tension is regulated. The endothelium covers Descemet's membrane, passes over the ligamentum pectinatum, and so goes to the anterior surface of the iris. The nutrition of the cornea is provided by means of its lymph flow derived from blood-vessels in the neighbouring structures. Thus the anterior vessels of the conjunctiva, those of the sclerotic, and those in the ciliary body all contribute.

Examination of the Cornea.—In injuries or disease of the cornea there is usually considerable pain, photophobia, lachrymation, and a tight closing of the eyelids (**blepharospasm**) on any attempt being made to examine the eye. A satisfactory examination may sometimes be made in diffuse daylight without manipulating the eyelids or using a dilator, and for this to be possible the observer must avoid any approach of his hand to the animal's eye. By attracting the animal's attention and getting the eye to move in the various directions this method may sometimes determine all that is required. Failing this the eyelids must be held apart with the finger and thumb, and if there is much blepharospasm a few drops of cocaine solution should be instilled into the eye. The use of a convex lens to focus a bright gleam of light on to the cornea is of great assistance. With this same focal illumination the surgeon may use in addition a magnifying glass through which to observe the well-lighted corneal surface. On the other hand, an examination may be made in a dark-room by means of the ophthalmoscope and a lamp. The lamp is held behind the animal's head and the light is reflected on to the cornea by means of the ophthalmoscope mirror. Here again a magnifying lens may be introduced if desired.[1] If ulcer is suspected an instillation of fluorescein should be used to determine the point.

Keratitis (Inflammation of the Cornea).—The cornea from its position is especially susceptible to injury by external agents and also to bacterial invasion. This latter may occur directly, especially following some damage to the surface epithelium. It may also occur by extension from the infected conjunctiva, and in addition the cornea may share in scleral and uveal infections because of its blood supply.

Causes.—Wounds of the cornea, injuries by foreign bodies, such as grass seeds, thorns, bits of chaff, or grit; chemical irritants, such as quicklime or acids; burns from sparks: all these are common causes of keratitis, and bacterial invasion may follow any of them. Frequently the cornea becomes infected by extension in cases of conjunctivitis, particularly of the purulent type. Various bacteria are associated with corneal infection, most commonly streptococci, staphylococci, and the pyogenic bacilli. The hay bacillus (*B. subtilis*) is also a cause, and moulds such as *aspergillus* may also occur. In man the *pneumococcus* is often the cause of purulent ulcers and hypopyon.

Chronic sources of irritation such as entropion and trichiasis predispose to keratitis, and any purulent chronic infection in proximity to the cornea is a fruitful cause. The cornea is readily susceptible to any general impairment of vitality, and with such its powers of resistance are easily overcome. Thus in old age, or in very young animals, or in debilitated subjects, keratitis is very likely to occur. In certain specific diseases, notably distemper of the dog, and to a less degree influenza of the horse, keratitis is a common complication. Insects and nematode worms may also set up keratitis.

Symptoms.—The earliest symptoms of keratitis are very similar to those of conjunctivitis, namely, lachrymation with a flow of tears over the face, photophobia, and more or less closure of the eyelids. When the eye is examined there is noticed a marked congestion of the vessels in the sclerotic immediately surrounding the cornea. The cornea itself may be quite clear and transparent in an early case, but there is very soon evidence of more or less dense opacity. This varies from a mere haziness or filminess of the cornea up through a diffuse light blue but transparent infiltration to a dense white opacity. The opacity may be quite localized to the seat of injury—so as to be linear or speck-like, as in the case of injury caused by a whiplash—or the whole surface of the cornea may be involved.

Then again the surface of the cornea may be quite smooth, unabraded, and intact, or it may be ulcerated. It is of considerable practical importance to determine this point, and for this purpose examination may be made with a biconvex hand-lens, such as a reading-glass, or the lens supplied for use with the ophthalmoscope. The instillation of one or two drops of a solution of *fluorescein* (2 per cent) will make evident any surface abrasion or ulcer, since the stain only affects the damaged surface, staining it a brilliant greenish-yellow.

Lesions and Terminations.—Following on any localized injury with infection, or on a bacterial invasion without injury, there is an infiltration of the inter-lamellar lymph spaces, so that these become more or less distended with fluid exudate, which may throw down a precipitate of fibrin, and closely packed with leucocytes. If this infiltration only involves the superficial layers, the cornea will appear mottled and often lustreless in patches due to swelling and lifting of the epithelium.

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[1] For details see "Examination of the Eyes," p. 743.

In a simple case the structural changes may go no further. With cessation of the injury, resolution begins, the outpoured lymph and dead cells are removed or absorbed, and the cornea again becomes clear and returns to the normal. In other cases the infiltration is deep-seated (*interstitial keratitis*) and of a chronic nature. The opacity spreads until it covers a large part of the cornea, and along with the opacity there is a formation of new blood-vessels in the posterior layers of the cornea (*pannus*). These may be quite evident to the naked eye or only with a magnifying glass. In different cases the opacity varies greatly in density from a mere haze (*nebula*) to a dense white non-translucent opacity (*leucoma*). This variety of case, without any tendency to ulceration or abscess, is generally found as a sequel to debilitating diseases, such as distemper in the dog, or as a result of constitutional defects, causing malnutrition of the cornea. With improvement in general health the opacity may be gradually absorbed, though very frequently not completely. Often a deep opaque spot may be left in the centre of the cornea. In chronic cases in the dog an old opacity often becomes pigmented with a dense black pigment (*melanin*), usually at the periphery, but sometimes over a large part of the surface of the cornea. The pigmented opacity is never cleared up.

In a more acute case leucocytic infiltration is rapid. The leucocytes invade the infected corneal parenchyma in large numbers, and as a result of the bacterial toxic action many of these cells die, as do also the cells of the corneal tissue. Thus the lamellæ and eventually the epithelial cells become necrosed and strip off, leaving an *ulcer*.

Sometimes a line of defence may be set up and outside this the leucocytes may remain active. In such a case the central area sloughs, leaving a clean-cut ulcer. With a more virulent infection, on the other hand, the ulceration extends both over the surface and also to the deeper layers. At one or more points in the floor of the ulcer, burrowing goes on until Descemet's membrane is laid bare. From increased tension of the aqueous humour in the anterior chamber this elastic membrane may bulge out, looking like a transparent bead projecting out from the ulcer. After a time this usually ruptures, allowing of the escape of aqueous humour, or the prolapse and protrusion of the iris, and even dislocation and escape of the lens. The prolapsed iris caught in the edges of the wound is often bulged out on account of intraocular tension. The resulting mass, covered with a layer of lymph, which later becomes organized, is called a *staphyloma*.

In severe cases, even before perforation, the infection from what is really a corneal abscess spreads to the anterior chamber and reaches the iris. The aqueous humour becomes turbid from the presence of leucocytes and fibrin. The endothelium lining Descemet's membrane and covering the front of the iris proliferates and desquamates cells, and pours out an exudate so that there appears to be a collection of pus in the lower part of the anterior chamber, and fibrinous deposit is formed on the endothelial surfaces. This condition is known as *hypopyon*, and as a result the inflamed surfaces of cornea (posterior surface) and iris may adhere together (anterior *synechia*). With perforation and consequent lessened tension the infection may be got rid of, and healing may commence. On the other hand, the infection may spread and *panophthalmitis* with complete destruction of the eye may result.

Following many severe cases of keratitis (and, as we have seen, as a complication of chronic follicular conjunctivitis) the condition known as *pannus* may be brought about, in which with a diffuse opacity there are numerous fine blood-vessels running in over the cornea. Following the infiltration of the cornea, the vessels around its margin give off numerous capillary loops, and these spread in towards the centre under the epithelium. If an ulcer is present the vessels run in to its edges. During this time there may often be intense conjunctival congestion and also iritis. In other cases the vascularization of the scar occurs during healing and is accompanied by little pain.

In the healing of an ulcer the corneal corpuscles, acting like connective-tissue corpuscles, proliferate to fill up the defect in tissue with a modified connective tissue, fibrous and vascular. The epithelial cells at the edge of the ulcer grow in and strive to cover the defect. Any protruding part of a prolapsed iris will slough off. With time the scar tissue thus formed becomes somewhat less opaque and its fibres more regularly arranged and even laminated, but with an injury of any magnitude a permanent opacity is bound to result.

Where there has been no ulceration there is much greater chance of clearing, and after some months the vessels in a pannus may be so reduced as to be invisible to the naked eye, although a haziness of the cornea will still be evident.

Treatment.—An examination of the cornea should first be made to determine the presence, if any, of a foreign body on or embedded in its substance. A brown rust stain round about the wound will be seen if a particle of iron or steel is the offending body. For removal it is necessary as a rule to use cocaine, or even a general anæsthetic in the larger animals, in order completely to control movement of the eye, and then a spud or blunt needle or a small curette may be used. After removal, or even before this is attempted, especially if the foreign body has penetrated into the anterior chamber, an antiseptic eye lotion, either boracic acid or perchloride of mercury (1 in 10,000), should be used to wash away mucus and discharge and lessen the risk of infection. If there is danger of pushing the foreign body into the anterior chamber during the attempt at removal, a flat keratome should be inserted into the cornea behind it, so giving a firm support. The subsequent treatment is as for a corneal wound or ulcer.

In all cases of keratitis it is important to determine the presence of any abrasion or ulcer by means of fluorescein, and in case such is found, lotions containing lead salts or permanganate of potash should be avoided—the former agent because an insoluble lead albuminate is formed and a chronic opacity results; the latter because with this lotion the cement substance between lamellæ appears to be dissolved and the ulcer quickly spreads and deepens.

Where there is no wound, but only opacity due to infiltration, the indications are for antiseptic lotions to be used frequently, followed at each dressing by some stimulant astringent agent to promote absorption and improved tone. Such agents are silver nitrate ½ to 1 per cent in distilled water, zinc sulphate in the same strength, or sodium hyposulphite 2 per cent. Ointments of yellow oxide, or nitrate of mercury (10 grains to 1 oz. of vaseline), may be smeared inside the lids night and morning with good effect. General treatment by tonics, such as iron, quinine, strychnine, or arsenic, and improved diet, is important: in fact, any measures to improve the circulation and general constitution.

Where there is a wound or ulcer, treatment should be directed to the prevention of complications, such as perforation with prolapse of the iris and subsequent synechia or staphyloma. Atropine solution should be at once instilled to withdraw the iris so that, if perforation occur, it is out of harm's way. The suggestion is sometimes made that myotics, such as eserine, should be used because of a supposed effect in lessening intraocular tension. This lessening of tension is by no means a certain effect of myotics, and the added risk of iris prolapse in all except marginal corneal ulcers is of much greater importance. Further, with corneal ulcer there is often iritis and more or less hypopyon, and here again atropine should be used.

The ulcer itself is treated by means of the usual antiseptic lotions, but with any tendency to spread or become purulent it will require special methods.

Its surface may be disinfected by means of tincture of iodine or hydrogen peroxide, applied by means of a fine camel-hair brush, or pure carbolic acid applied on a fine piece of wood such as a match—the excess being carefully wiped away. An insufflation of finely powdered calomel on the surface may also prove beneficial. In the human subject the galvano-cautery is frequently used for the same purpose. A very useful agent in severe keratitis with or without ulceration is dionine—a morphine derivative—which causes considerable vascular dilatation with chemosis, and a flow of lymph. Dionine is used in 5 per cent solution and instilled on alternate days.

With a spreading or deep ulcer threatening perforation, or where hypopyon is present, it is often of great advantage to anticipate the perforation by performing the operation of *paracentesis* or tapping of the anterior chamber. This can be done with a small keratome or a narrow-bladed knife, which is passed through the cornea obliquely to the surface, entering at a point 2 or 3 millimetres outside one edge of the ulcer. The blade traverses the anterior chamber in a plane parallel to and in front of the iris, and emerges 2 or 3 millimetres on the further side of the ulcer margin. The blade is then turned outward and cuts through the cornea so as to divide the saucer-shaped ulcer in two. The aqueous humour and any hypopyon escape, and in order to avoid prolapse of the iris the outward cut should be made very slowly, whilst atropine should be used before the operation. Such procedure lessens pain, promotes healing of the ulcer, and leaves a slight linear scar much less objectionable than the large scar, synechia, and possible staphyloma produced by natural perforation of the ulcer. If perforation has already occurred the iris may be already prolapsed and involved in the ulcer. In such a case there is grave danger of infection spreading to all parts of the eye through the infected iris vessels. Any adhesions between the prolapsed iris and the wound edges must be gently broken down with a probe, the iris drawn a little further forward in the wound and, after efficient disinfection, cut off flush with the surface of the cornea. The iris may now be pushed back through the wound into the anterior chamber by means of a probe or blunt needle. If panophthalmitis results, extirpation of the eyeball is the only treatment. In cases of staphyloma evisceration of all the structures inside the sclerotic is a useful operation because of the freely movable stump which is left on which to insert an artificial eye. Thorough disinfection of the cavity is called for, and the wound is drawn together with sutures.

Many cases of keratitis, especially if complicated with iritis, are benefited by subconjunctival injections of 4 per cent saline solution. The injection of from 10 minims in the dog to 1 drachm in the horse is made under the bulbar conjunctiva outside the sclerotic, the needle being directed away from the cornea. Considerable pain results and a good deal of injection of vessels and even chemosis, so that it is advisable to use a cocaine lotion before the saline injection is made. The vascular disturbance and stimulation is the probable explanation of the beneficial results, and a second injection should not be made until the reaction of the former one has subsided.

Warm fomentations to the eye and the application of a pressure bandage are to be recommended in the routine treatment of corneal ulcers or abscesses, since they not only relieve pain but promote resolution and healing and tend to prevent perforation.

They are contra-indicated only when there is purulent conjunctivitis as a complication, in which case no dressing which retains the discharge must be used. The dense opacities and scars which are left after serious keratitis, ulcers and wounds, tend, if unpigmented, to contract and become thinner. With vascularization and connective-tissue formation of any magnitude in the cornea, however, the opacity is permanent. Its effect on vision depends on its extent and position. If marginal and of small extent, the opacity causes little inconvenience in an animal, though it is a blemish and disfigurement. If central it is much more serious. The use of the silver nitrate pencil is to be recommended for promoting reduction of a localized but prominent scar. The application of pure carbolic acid to a localized vascular patch may also assist in clearing it up.

Tattooing with Indian ink by means of a fine needle may be used to hide the blemish caused by a dense white opacity. Iridectomy (*q.v.*) so as to enlarge the pupillary opening may be practised with benefit to the sight where the opacity is central or affects only parts of the cornea. The iris opposite to the clear corneal area is removed so that light enters there and sight is restored to an otherwise blind eye.

VII. Diseases of the Uveal Tract

The *uveal tract* is made up of the *iris*, the *ciliary body*, and the *choroid*. These three structures are very intimately connected with one another, are very similar histologically, and have the same blood supply. The consequence is that in all cases of severe iritis there is some degree of inflammation of the ciliary body (*cyclitis*), and infection may easily spread to the choroid, though this is not so common. Thus there may be the three conditions :

Iritis.—Inflammation of the iris.

Cyclitis.—Inflammation of the ciliary body.

Choroiditis.—Inflammation of the choroid.

Causes.—*Iritis* may be primary, occurring as an independent condition or as a complication of or sequel to some systemic disease, or it may be secondary to an infection of the conjunctiva or cornea. In either case the ciliary body may be, and commonly is, involved when the condition is known as *irido-cyclitis*.

Primary iritis or *irido-cyclitis* is seen in its most characteristic form in the disease known as periodic or specific ophthalmia of the horse (*q.v.*).

It may also occur as a complication in cases of influenza and purpura hæmorrhagica in the horse, after acute febrile diseases in cattle, or distemper in the dog. It is definitely associated with rheumatism in the human subject. Inflammation of the uveal tract, iris, ciliary body, and often choroid as well, is, however, much more commonly due to an extension of infection from conjunctivitis or keratitis, especially with an ulcerated perforated cornea.

Similarly wounds of the cornea or sclerotic, with prolapse of iris or choroid, provide an easy entrance for infection to the uveal tract. This affords one urgent reason for preventing the inclusion of portions of iris or choroid in a healing wound or ulcer, since these very vascular structures facilitate infection.

Symptoms.—With inflammation of the iris and ciliary body there are from the beginning lachrymation and photophobia, although these are often not as marked as in affections of the cornea. The eyelids, however, are kept more or less closed, and the animal seeks a shady place. It may soon be evident that there is some dimness of vision, although that being subjective is not easy to determine. On examination of the eye certain characteristic points may be noticed. There is congestion of the ciliary vessels in a narrow ring just outside the limbus of the cornea. If uncomplicated with conjunctivitis or keratitis, there is no discharge from the eye. The iris itself is seen to have a somewhat dull appearance ; its lustre is lessened, and its colour changed to a murky yellow. The pupil is contracted and the iris immobile, not reacting readily to light reflexes. At first this contracted pupil is due to spasm of the sphincter muscle of the iris, but with a throwing out of inflammatory exudate from the inflamed iris adhesion takes place between the posterior surface of the iris and the lens (*posterior synechia*), and the contracted pupil is permanent. The aqueous humour is often rendered turbid by the pouring out of inflammatory exudate, and an appearance simulating hypopyon results from the deposition of jelly-like lymph clots in the anterior chamber. The cornea itself is often dim and blurred because of this lymph on its posterior surface.

A comparison with the normal iris of the sound eye is always advisable in any early case of iritis if there is any doubt about the condition.

Iritis is a painful condition. The animal hangs his head, avoids light, may show some general symptoms of loss of appetite and some rise of temperature. It must always be considered a serious condition, whether arising primarily or as a complication of conjunctival or corneal disease.

Terminations.—The results of iritis may be serious. Posterior synechia—the adhesion of the inflamed iris to the anterior surface of the lens—is a common result, and it affects the subsequent mobility of the iris, so interfering with the entrance of light into the eye. It may be detected by the use of atropine, for the pupil fails to dilate. If the adhesions are only partial, the iris is retracted where free, but fails to be withdrawn where attached, so that an irregular-shaped pupil is seen. Where the adhesions are complete all round the pupillary margin no retraction of the iris is possible, and the condition is one of complete synechia. By interference with the normal drainage of the aqueous humour this condition may lead to that of *glaucoma*, with blindness as a result.

Irido-cyclitis is likely to be followed by some blurring of the cornea by the deposition of inflammatory exudate or lymph on its posterior surface (*keratitis punctata*). Further, disease of the ciliary body has a serious effect on the nutrition of the lens, and as a consequence of cyclitis *cataract* is very commonly produced. Purulent choroiditis pointing to a serious intra-ocular infection is likely to be followed by *panophthalmitis*, with destruction of the eye.

Treatment.—When iritis or irido-cyclitis is diagnosed active treatment must be undertaken at once. Atropine—whether in 1 per cent solution of the sulphate in water, or as a 1 per cent ointment, or in the form of lamellæ—is to be applied early and continued throughout the treatment. Its effect is to paralyse the *sphincter iridis* and so give rest to the muscle. It also lessens hyperæmia and exudation by lessening the surface area of the iris, and by dilating the pupil it withdraws the anterior edge of the iris from contact with the lens and so prevents the possibility of synechia. If adhesions have just commenced to form they may be broken down by pushing the use of atropine solution, a few drops at intervals of five minutes, over a period of half to one hour, so that its effects are kept up at full strength. Sometimes the skin of the eyelids may be irritated by the frequent use of atropine, and to prevent this the lids should be lightly smeared with vaseline before using the lotion.

The patient should be kept in a shaded or darkened place throughout the treatment. Hot fomentations over the orbital region have a soothing effect. A purgative is advisable at the onset. If the condition is thought to be due to rheumatism, salicylates must be given. Where lymph is thrown out into the anterior chamber it will probably be found necessary to operate for its removal. In severe cases the subconjunctival injection of hypertonic saline solution (4 per cent), or of Lugol's solution of iodine, is a measure which should be tried. The injection should be preceded by the use of a few drops of cocaine solution into the eye. It is made by means of a fine hypodermic needle inserted under the bulbar conjunctiva outside the corneal margin, the needle being directed away from the cornea. In the horse or ox one or two drachms of the salt solution should be injected, in the dog from 5 to 20 minims, and the injection should not be repeated until the reaction following the first injection has subsided. Of Lugol's solution the amount to be injected should not exceed 2 c.c.

In cases of suppurative choroiditis or panophthalmitis evisceration of the contents of the eyeball is the best procedure. Complete enucleation of the eyeball whilst there is considerable virulent infection is often dangerous, as there is a chance of meningeal infection from the orbital cavity.

Periodic Ophthalmia of the Horse.—This condition, known as *periodic ophthalmia* from its extraordinary tendency to recur again and again, *specific ophthalmia* because it occurs as a primary affection irrespective of any other disease, and moon-blindness because of its periodicity, is peculiar to equines. It is essentially an inflammation of the uveal tract, especially the iris and ciliary body.

Causes.—The etiology of this disease is very little understood. In Great Britain and in Australia the condition must be considered distinctly rare in normal times. During the war many more cases than usual have been seen, and there can be little doubt that the congregating of a large number of horses on board ship or in camps has a marked effect in producing the disease. In any case, periodic ophthalmia is much less common nowadays than it was fifty years ago. There is ample evidence that the disease used to occur almost as an enzoötic in many old coaching stables in the days of the mail-coach. Improved sanitation of stables, and especially increased light and plenty of fresh air, have had a very material effect in lessening the number of cases. A climatic factor of some importance is that of damp surroundings and wet weather. Swampy districts, such as the fens, parts of Ireland, Holland, and during the war Flanders, provide many more cases than dry uplands. Again, poor feeding and hard work leading to a debilitated condition render horses more susceptible than those in good condition, although debility is by no means an essential condition. Heredity has been blamed, although it is extremely difficult to see how it can have any effect whatsoever.

Much investigation work has been done to discover a specific micro-organism, though so far without any definite accepted result. Various bacilli and strepto- and staphylococci have been obtained from eyes affected with periodic ophthalmia, and in some cases pure cultures of these organisms when inoculated into healthy eyes have produced irido-cyclitis with symptoms similar to the original disease. Such an experiment is by no means convincing, and it would require to be shown that the iritis produced showed recurrence or periodicity as a prominent feature as well as other characteristic effects before the culture used could be considered a sufficient cause of the natural disease. When it is remembered that syphilis, gonorrhœa, and rheumatism are the commonest causes of recurrent iritis in man, it appears likely that periodic ophthalmia of the horse is really a sign of a general infection rather than a merely local one. It is not the common experience that the disease is markedly contagious. As a rule, the cases are isolated ones, with a large number of unaffected horses in the stable or camp.

The age incidence is probably a coincidence rather than the effect of any special age susceptibility. Four- and five-year-old horses would probably be found to furnish the largest number of cases in civil practice, for the reason that they are at that age first congregated into close, ill-ventilated stables.

Symptoms.—In its physical signs periodic ophthalmia is simply an irido-cyclitis, with sometimes choroiditis. The condition may be acute, but is usually subacute in character. The onset is sudden. Usually the first indication of any disease is to find the horse in the morning with half-closed eyelids on one side, with a trickle of tears down the face, and avoiding any bright light. On examination the eyeball is seen to be somewhat sunken, the horse objects to manipulation, and on attempting this the lids are tightly closed. There is more or less conjunctival congestion, but usually marked ciliary congestion just outside the corneal limbus, whilst the pupil is contracted. The animal's temperature may be raised a little, sometimes as much as three or four degrees, and the appetite is sometimes affected. After such an onset the characteristic signs gradually develop. The iris loses its lustre, looks dull and of a murky yellow colour; the aqueous humour becomes more or less turbid at first, whilst within a day or two a mass of coagulated and often blood-stained lymph comes to lie at the bottom of the anterior chamber. The cornea is more or less blurred, and fine blood-vessels may be seen in the corneal area running in from the ciliary vessels. This period of inflammation may last from two or four up to ten days. The condition is a painful one; it affects, as a rule, only one eye, and a comparison with the sound eye makes the abnormalities of the affected one the more evident. After this first stage there is a gradual decline of all the symptoms. Lachrymation and photophobia lessen, the anterior chamber clears up, exuded lymph, if not very large, in amount, is absorbed, and the iris becomes mobile once more. Thus the eye returns almost, if not quite, to the normal condition. There is often left some slight steaminess of the cornea, and the lustre of the iris may not be quite so clear as in the sound eye, but only a close inspection will detect the difference. The whole period of the attack is usually from two to three weeks. Then occurs the characteristic recurrence. The second attack may be in the same eye, or it may often pick out the other one. It occurs in from two to three weeks to as many months after the first attack. In this second attack the symptoms are much the same as before, but resolution after the attack is not so complete. After two or three attacks the cornea may show some permanent vascularization round its outer edge, the iris will probably have contracted some adhesions either to lens or cornea, so that the pupil when dilated has an irregular border, and the lens will usually show the white specks of early cataract. After several attacks the lens shows a number of fleecy lines running in towards the centre, and soon the whole crystalline substance has become a white opaque mass, and the animal is now quite blind. The later attacks are usually of shorter duration than the first one, but each adds to the permanent defect left in the eye. In eyes which have been attacked several times, on post-mortem it is usually found that the vitreous humour is of a faint yellow to an amber colour and lessened in amount. The choroid may be thickened, often in patches, the lens or its capsule opaque, and there are the usual changes due to irido-cyclitis.

Treatment.—Something can be done in the way of prevention by an understanding of the predisposing causes. In fact, in civil life improved stable hygiene has made the disease a comparatively rare one. The affected animal should be placed in a roomy, shaded, but well-ventilated box, or if in the open should be provided with an eye-shade. Atropine should be used from the commencement, and a spray consisting of atropine sulphate 5 grains, cocaine hydrochloride 5 grains, and boric acid 10 grains to 1 oz. of distilled water, is very useful. The horse should have a dose of physic, and thereafter should have light laxative diet and little corn. Fomentations give relief during the inflammatory stage and quicken the clearing-up process. Subconjunctival injections of hypertonic saline (4 per cent) should be used in the early stages as soon as the atropine solution has had time to act. An alternative method is that described by Wiggs, and reported on favourably by Chambers,[1] in which 1 c.c. of Lugol's solution of iodine is injected through the skin over the supraorbital fossa deeply into the supraorbital fat. The skin is disinfected, the needle inserted to a depth of half an inch or a little more, and the injection made. A second injection, whether subconjunctival or interstitial, should not be made until the reaction caused by the first one has subsided—usually in three or four days' time. In an outbreak of specific ophthalmia in cattle in Rhodesia in 1913, Chambers reports the result of this treatment in a hundred cases. "Sixty-three were cured by the first injection, twenty-six had two injections, and eleven did not improve." The treatment of such complications as arise—synechia, hypopyon, etc.—is as described under "Iritis."

Iridectomy.—The operation for the removal of a portion of the iris is performed either to allow of the entrance into the eye of light rays in cases where entrance through the pupil is prevented by a central cataract or a corneal opacity; or to reduce abnormally high intraocular tension such as occurs in glaucoma; or for the purpose of removing a foreign body embedded in the iris.

The operation consists in removing a small portion of the iris, so providing an opening or *coloboma* in the iris ring, through a corneal incision. The size of the coloboma has to be determined by the object for which the operation is performed. For optical purposes a narrow coloboma is preferred in order that too much light should not enter the eye, but for glaucoma the opening should be wide. The width is dependent on the length of the corneal incision. In the dog the opening is best made in the lower internal quadrant.

The animal being anæsthetized and a speculum applied, fixation forceps are put on just outside the corneo-scleral margin at a point opposite to where the coloboma is to be. The corneal incision may be made either with a keratome or a Graefe knife, but in either case the knife must be sharp. Using a keratome, the knife is inserted into the cornea, and when the point is in the anterior chamber the blade is directed parallel to the cornea and iris as near to the deep surface of the cornea as possible, so as to avoid injury to the iris or lens. When the corneal incision is wide enough the knife is slowly withdrawn and aqueous humour allowed to escape. The anterior chamber thus becomes shallower and the iris and lens come forward. The portion of iris to be removed can now be withdrawn through the corneal incision with iris forceps or a Tyrrell's hook. The closed forceps or hook are passed into the anterior chamber, and when the points are near the pupillary margin of the iris they are opened widely to catch up the iris and withdraw it. The desired amount is then snipped off with fine curved scissors, the incision being in the radial direction. No tags of iris should be left in the corneal wound, and any irregularity or folding of the edges of the coloboma should be reduced by careful smoothing with a blunt needle or spatula. This toilet of the iris is an important factor in the success of the operation. A dressing and bandage are then applied and the wound treated in the ordinary way.

VIII. Diseases of the Sclerotic

These are very uncommon except as a result of direct injury. Marked congestion of the vessels running over the white part of the eye (sclera) may often suggest inflammation of the sclera, or *scleritis*, but in fact this condition is uncommon and ill-defined. The congested vessels are either concerned in bulbar conjunctivitis, in which case they are movable over the apparently affected sclera, so proving them to be conjunctival, or they are confined to a narrow band just outside the limbus of the cornea, in which case they denote ciliary congestion and point to inflammation of the iris and ciliary body.

Wounds of the sclera are serious in that they often allow of prolapse of the choroid, or of the iris, or of escape of vitreous humour. They may also allow of infection of the interior of the eye and so set up panophthalmitis.

Treatment.—A careful examination under cocaine is called for to determine the extent of the damage. A simple wound should be sutured after disinfection of the conjunctival sac and exposed sclerotic. If parts of the choroid or iris are prolapsed the adhesions, if any, must be carefully separated from the wound edges, infected and damaged parts snipped off with scissors, the wound disinfected and sutured. This procedure will usually require a general anæsthetic. After operation a dressing and bandage should be applied.

If the damage is extensive, or the ocular contents have escaped through the wound, or in cases where intraocular infection has certainly occurred, the eyeball should be excised.

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[1] See *Veterinary Journal*, 1917.

IX. Diseases of the Vitreous

The *vitreous humour* is subject to very few diseased conditions, and these are usually the result of extension from the choroid, ciliary body, or more commonly the direct result of wounds or the presence of foreign bodies.

Abscess.—Pus in the vitreous humour may result from spreading infection in a case of purulent choroiditis. Such a condition soon extends to other neighbouring structures, and *panophthalmitis* is the result.

Hæmorrhage.—Blood may be poured out into the vitreous as a result of a blow on the eye. When the swelling of the eyelids and surrounding parts has subsided the animal may be found to be blind. The pupil is dilated, but on throwing a beam of light into the eye with the ophthalmoscope no light reflex is seen and the pupil remains black and unilluminated. If only a small amount of blood has been thrown out it will show up as black spots with illuminated areas around them.

Absorption of small deposits of blood may take place, but with the vitreous full of blood no cure is possible.

Foreign Bodies in the Vitreous.—The effects will vary, depending on (1) whether infective material containing micro-organisms entered with the foreign body, and (2) on its composition.

With infection there is likely to be an extension until panophthalmitis occurs. If the foreign substance be a piece of iron or steel, rust will be formed and discoloration of the vitreous and iris and other structures will follow. Usually an intense inflammation will be set up.

Other substances, such as a lead pellet, also usually cause inflammation when lodged in the vitreous, and it is in these cases particularly that the condition known as *sympathetic ophthalmia* (*q.v.*), affecting the other or sound eye, is to be feared as a sequel.

Foreign bodies in the vitreous may be diagnosed by the appearance and history of a wound of the cornea or sclera, by using the ophthalmoscope, or, in the case of many metals, by means of an X-ray apparatus.

Treatment.—When ophthalmitis threatens, the eyeball should be excised. Foreign bodies may sometimes be removed successfully through a scleral incision which allows an escape of the vitreous carrying with it the foreign body. In the case of iron and steel particles an electro-magnet can be used to draw them out, or, at any rate, into the anterior chamber, from which they can be removed. If a foreign body is known to be in the vitreous and cannot be removed, it is advisable to enucleate the eyeball.

Sympathetic ophthalmia is a condition of general plastic inflammation of the uveal tract of one eye arising as a result of *uveitis* of the other eye. The two eyes can be distinguished as the first and the second eye, or as the exciting eye and the sympathetic eye.

Pathology.—The pathology of sympathetic ophthalmia is not understood. It is remarkable that the condition is specially liable to occur after perforating wounds involving either anterior chamber or vitreous humour of the exciting eye. On the other hand, the condition does not follow a purulent uveitis or panophthalmitis due to infection with pyogenic organisms. Again, blows and injuries to the eyes without rupture of the conjunctiva do not bring about sympathetic ophthalmia in the second eye. Thus the evidence points to a specific infecting agent as the cause, but not a pyogenic organism.

At a varying period after the injury setting up ophthalmia in the first eye, it may be weeks or months, the symptoms of *iritis* or *iridocyclitis* and *choroiditis* are seen in the second eye, occurring without any obvious cause.

Treatment.—The condition is not common in the domesticated animals, but the following rules should be observed in dealing with an eye affected with a perforating wound, so as to lessen the risk to the second eye:

(1) If the injury has destroyed the sight of the eye, the organ should be removed. This will effectively prevent any danger to the other eye.

(2) If sympathetic ophthalmia has already commenced in the second eye, on no account remove the first eye if possessed of any sight at all.

The treatment of the affected (sympathizing) eye is as for uveitis in general.[1]

Panophthalmitis is the term applied to a general suppurative inflammation of the internal structures of the eye following septic infection. It is possible for the eye to become infected as the result of a general blood infection with pyæmia, but this is very rare, and the local condition would be overshadowed by the general constitutional symptoms of septic poisoning. For practical purposes panophthalmitis is caused by local infection through a wound. A perforating wound of the eye, the result of an injury with the implantation of pyogenic organisms at the time of the injury, is a very common cause. The entrance of organisms as a result of ulceration of the cornea following keratitis, or infection following a surgical operation such as paracentesis or a cataract operation, or iridectomy, may also be the cause of panophthalmitis. The offending micro-organisms are usually *streptococci*, but other pus-producing organisms may also be present.

Symptoms.—As a result of the infection there is considerable pain, photophobia, and excessive lachrymation. The eyelids are markedly swollen, and there is more or less chemosis. The cornea speedily becomes opaque, and the globe is generally swollen as a result of œdema and its pus contents.

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[1] See "Diseases of the Uveal Tract," p. 761.

In a short time the whole contents of the eye are involved in the suppurative process and more or less broken down (*phthisis bulbi*). The discharge is muco-purulent and blood-stained, often offensive. With opening up of the original wound or rupture of what is now an abscess cavity the broken-down contents of the globe will escape. Following this collapse of the eyeball the acute inflammation will usually gradually subside, the discharge become less, and the wound heal by granulation. The result is a shrunken, sightless globe, usually painless, but sometimes remaining irritable and a constant source of trouble.

In a less favourable case infection may spread by the ophthalmic veins to the venous sinuses and so to the meninges, or a general septic infection with pyæmia or septicæmia may be set up.

Treatment.—When panophthalmitis is definitely present it is unlikely that any treatment will avail to save the eye. Hot fomentations to the eye and irrigation with 1 per cent creolin solution will help to lessen the pain and get rid of the discharge, but the only choice is between enucleation of the whole globe or evisceration of its contents. Some surgeons refuse to excise the eyeball whilst the acute suppurative process is still going on, because of the risk of setting up septic meningitis. In this case evisceration may be practised. This risk is not, however, a very serious one, and it is undoubtedly better in the great majority of cases to proceed directly to excise the eyeball.

Excision or Enucleation of the Eye.—The animal having been anæsthetized, all discharge is thoroughly washed away by means of plentiful irrigations with sublimate solution (1 in 5000) or sterile saline, the eyelids are cleansed, and a speculum inserted. The globe is seized with a pair of fixation forceps and an incision is made in the conjunctiva all round the corneal margin. The bulbar conjunctiva is now separated from the globe with scissors and forceps, and a blunt hook (a strabismus hook is the best in the dog, but is too small in the horse) is passed under each of the ocular muscles in turn so that they may be cut through as near to their insertion to the eye as possible. Pressure is then put on the speculum so as to make the eyeball bulge forward, and with a pair of rat-tooth forceps one of the muscle insertions is seized and the globe drawn forward. A pair of probe-pointed curved scissors are now passed back behind the globe so as to divide the retractor muscle and the optic nerve as far back as possible. To avoid any chance of infection the orbital cavity should now be thoroughly irrigated with hot sublimate solution (1 in 5000) or hot sterile saline solution. This will at the same time control any hæmorrhage. A small pledget of gauze is left in the cavity and retained by a suture uniting the eyelids. An outside dressing and bandage may be put on if thought necessary. The cavity should be irrigated and the dressing reapplied daily for a few days.

When all discharge has ceased and the stump has become firm, say in about six or eight weeks' time, an artificial eye may be put in. Otherwise the margins of the eyelids may be pared and then united by means of sutures. It is advisable to leave a small space at the nasal canthus unsutured at first to allow of the escape of any discharge. When the cavity is quite certainly dry this space may be closed up.

X. Glaucoma

Glaucoma is a condition of which the pathology is somewhat obscure, but in which the essential symptom is increased intraocular tension. The increased tension is due to an overfulness of the globe with an excess of aqueous humour. The eyeball is consequently harder or firmer to the touch than normal, and the increased pressure can be determined either by the educated sense of touch in the surgeon or more accurately by an instrument called a *tonometer*, which measures the depression produced by resting the instrument on the cornea whilst placing graduated weights in the scale-pan. Glaucoma may be *primary* when it comes on without any antecedent definite recognizable disease of the eye, or *secondary* when it arises as a sequel to some previous eye disease or injury.

Etiology.—Normally the aqueous humour is constantly being secreted or expressed from the blood and as constantly being removed by the lymphatics and veins adjacent to the anterior chamber, so that the amount remains fairly constant. With continued secretion but non-removal the amount increases and the intraocular tension rises, so causing glaucoma.

The chief channel of exit for used-up aqueous humour is through the network or open spaces (spaces of Fontana) in the suspensory ligament (zonula of Zinn) of the lens. This zonula or suspensory ligament consists of delicate fibres running from the ciliary processes to the equator or edge of the lens, and between the fibres are spaces communicating with the anterior chamber and thence, with a barrier of endothelium only, with the *sinus venosus scleræ* or canal of Schlemm. This is a circular venous sinus near the corneo-scleral margin. The mechanism of the exit of excess of aqueous humour depends, therefore, on the patency of the angle of the anterior chamber, and if this angle is closed up the removal of fluid is at once prevented. In glaucoma the root or periphery of the iris is pressed forward and lies close up against the periphery of the cornea, so closing the angle. Priestley Smith has suggested that in many cases there is a too small circumlental space, and this agrees with the observation that small eyes are more often affected with glaucoma than those of normal size. The progressive increase in the size of the lens with age may thus account for glaucoma in old age. Any great increase of blood pressure, local or general, causing a congestion in the uveal tract and an excessive production of aqueous humour will also help to produce the condition.

Primary glaucoma usually affects both eyes, although the onset may not always be synchronous. There are two types, the chronic and the acute.

Simple Chronic Glaucoma.—*Symptoms.*—There is gradually increasing dimness of vision, but as the condition comes on slowly and insidiously this is often unnoticed for some considerable time in animals. Gradually the intraocular tension increases, but the external appearance of the eye is normal and the pupil may continue to react. On examining the eye with the ophthalmoscope the characteristic sign is the *cupping of the optic disc.* This occurs because the *lamina cribrosa*—the opening in the sclera through which the optic nerve enters—is the weakest part of the globe and becomes bulged out by the rise in pressure. This cupping of the optic disc causes the retinal vessels to look as though broken off at the margin of the papilla where they pass round the overhanging edge of the cup. Pulsation of the arteries may often be seen in the glaucomatous eye, because the increased pressure produces a resistance to the pulse wave.

The disease gradually progresses, and if left untreated eventually ends in total blindness.

Acute Glaucoma.—This comes on quite rapidly, and is accompanied by definite signs. There is high intraocular tension with dilatation and immobility of the pupil and congestion of the ciliary vessels, especially the veins. The cornea is more or less insensitive, the anterior chamber appears shallow and the iris pattern somewhat indistinct. Opacity of the cornea or a characteristic " steaminess " is brought about by œdema of its substance.

The acute symptoms may pass off in a few days, but the recovery is never quite complete. After an interval of a few weeks a second attack occurs, leaving the eye worse than before, and with two or three recurrences blindness ensues.

Primary glaucoma is a very rare condition in animals. It is doubtful if it ever occurs in the horse, but cases have been recorded in the dog. Möller states that he has never observed actual cupping of the optic disc in animals, but only a general condition of *hydrophthalmos.*

Secondary glaucoma arises as a sequel to other diseased conditions of the eye, usually of such a nature as to bring about a closure of the angle of the anterior chamber. Such conditions are complete posterior synechia, ulcers or wounds of the cornea with prolapse of the iris into the wound, dislocation of the crystalline lens into the anterior chamber, traumatic cataracts leading to swelling of the lens, intraocular tumours such as choroidal sarcoma or a glioma, and advanced irido-cyclitis.

Treatment.—The only successful treatment of glaucoma is by means of *iridectomy* (*q.v.*). The removal of a portion of iris, advocated for this purpose by von Graefe in 1857, has for its object the opening up of a path for the draining away of the excessive fluid in the anterior chamber. In a successful operation a sclero-corneal fistula is produced and a small portion of the root of the iris opposite the coloboma becomes folded up and rests in the wound, so keeping the channel patent. The ordinary myotics—eserine and pilocarpine—may be used with some slight advantage to lessen intraocular tension, but their action is temporary and purely palliative. Purgatives should be given in any acute case, and the animal should be restricted in diet.

XI. Disease of the Crystalline Lens

Structure.—The *crystalline lens* is an epithelial structure enclosed in a structureless elastic membrane or capsule, and suspended in the eye by means of the suspensory ligament or zonula of Zinn. The lens is a biconvex body situated in front of the vitreous humour, and behind the iris, which is in partial contact with its anterior surface. The *substance* of the lens consists of a central denser portion or nucleus, and a softer cortical portion. When hardened the lens substance is seen to be made up of a mass of fibres united to form concentric layers arranged like the layers of an onion.

The lens contains neither vessels nor nerves.

The *capsule* of the lens, though spoken of as an anterior and posterior capsule, is really a continuous covering, and regulates the nutrition of the lens substance which takes place by osmosis. The anterior portion of the capsule is lined with flat polygonal cells forming an epithelium on its lental or inner surface. This is the only portion of the capsule capable of proliferation.

The *suspensory ligament* or *zonula* is made up of delicate fibres which reach from the ciliary processes to join the lens capsule at the equator of the lens. The fibres of the ligament form an open network with spaces (spaces of Fontana) which contain aqueous humour and communicate with the posterior and anterior chambers.

The interval between the ciliary body and the lens is known as the circumferential or circumlental space.

Diseases of the Lens.—The lens is not capable of undergoing any active inflammatory process. What changes occur are of a degenerative nature and are known by the name of *cataract.* Apart from cataract the only diseases of the lens are congenital defects or abnormalities, and dislocation due to injury or disease of other eye structures.

Cataract.—Degeneration of the lens giving rise to opacities in that structure is known as *cataract.* Proliferation of the anterior capsular epithelium results in the condition known as *capsular cataract.*

Cataract is common in the horse and dog, but is also found in other animals. Wild animals in captivity appear singularly prone to the disease, and such is seen particularly in kangaroos and wallabies.

Pathology.—Since cataract is a degenerative condition, it will be easily understood that it occurs most frequently as a senile change. Further, any failure or irregularity in the nutrition of the lens is likely to be followed by cataract, so that disease in the adjacent structures, such as irido-cyclitis, glaucoma, intraocular tumours, and any damage to the capsule of the lens, are common causes. Constitutional disease may also affect the nutrition of the lens, and this is exemplified by the frequent occurrence of cataract associated with diabetes (glycosuria).

There can be little doubt that the conditions predisposing to cataract are frequently inherited, for congenital cataracts are not uncommon, and there is sufficient justification for the view that cataract may be in some cases hereditary, so that breeding from animals the subjects of non-traumatic cataract is inadvisable.

Cataracts may be classified as *primary* when they are either senile or congenital, or due to a constitutional defect such as diabetes; or *secondary* when they result from some disease of other structures in the eye, or from trauma involving the lens capsule. Further, from the surgical point of view cataracts are also classified according to whether the change in the lens is stationary or progressive, and according to the density and position of the opacity. An incipient cataract is one in which the change is just beginning and is not associated with much impairment of vision. Such a condition is progressive and passes on gradually to the stage of a *mature* cataract in which the lens has undergone complete degenerative change. In this stage illumination of the eye with the ophthalmoscope gives rise to no bright reflex from the fundus and no glittering sectors in the cortex of the lens, for the whole lens is opaque. A mature cataract may remain stationary in that condition, or it may go on to become *hypermature,* in which case there is often softening of the outer degenerated cortex, whilst the nucleus becomes dry, hard, and chalky. In this stage dislocation of the lens is apt to take place either into the anterior chamber or into the vitreous.

With regard to position, cataracts may be *nuclear* when the change begins in the centre of the lens, *polar* when the change is cortical and at the most prominent part of the convexity of the lens, either on the anterior or posterior aspect, and *capsular* where the change is affecting the anterior capsule or its epithelium rather than the lens substance. In animals cataract is usually of the diffuse type, going on to complete maturity, although in the horse the most important type is the incipient or partial speck-like cataract, because of its difficulty of detection. Such a speck-like opacity is always a serious defect, because, although it may remain quiescent for years, it may progress and eventually produce blindness, and it must therefore be considered an unsoundness when a horse is being examined prior to purchase. It is especially important in stallions or brood mares.

Secondary cataracts are commonly seen as a result of periodic ophthalmia (*q.v.*) of the horse, or severe iritis, cyclitis, or choroiditis in any animal. *Traumatic cataracts* follow any perforating injury which opens the capsule of the lens and admits the aqueous humour into the lens substance. The entrance of sharp instruments or foreign bodies through a wound of the cornea is very liable to cause traumatic cataract. Sometimes a blow on the eye without perforation may produce cataract by contusion and rupture of the lens capsule. A perforating ulcer of the cornea is a not uncommon cause of anterior polar or capsular cataract.

After a wound of the lens capsule the adjacent lens substance becomes opaque and then swells up into a woolly or fluffy-looking mass, and this change gradually extends to the whole lens. Along with this, there is gradual solution and absorption of the degenerated material by the aqueous humour, until in a few weeks the whole lens will be removed and the pupil will again appear black and clear. Sight can now be restored by providing a suitable convex lens in front of the eye. On the other hand, the injury may have resulted in infection of the eye as well as mere wounding of the lens capsule. Iritis may have been set up, or even panophthalmitis with complete destruction of the eye and incurable blindness.

Treatment.—The successful treatment of cataract is only by operation. In the early stages of the disease some have claimed to get improvement by the use of potassium iodide, but most practitioners will agree that it is of little or no value. Various operations are in use depending on the age of the animal and the condition of the cataract. In all cases there are certain preliminary points to be settled before proceeding with the operation. First, it is advisable to determine in the early stages of the cataract, before the lens becomes completely clouded, the normal condition of the fundus by ophthalmoscopic examination, and of the retina by the reaction of the iris to light stimulus. Then, when the cataract is mature and ready for operation, it is all-important to ensure a healthy condition of the conjunctiva before undertaking any operation. There should be complete freedom from conjunctivitis or blepharitis, or any condition likely to lead to infection of the wound. The eye should then be prepared for operation. The eyelashes should be cut short, the conjunctival sac thoroughly irrigated with normal saline or sterile boracic acid solution, and the eyelids painted with tincture of iodine. The question of anæsthesia,[1] whether general or local, has then to be determined, and finally the particular operation has to be decided on.

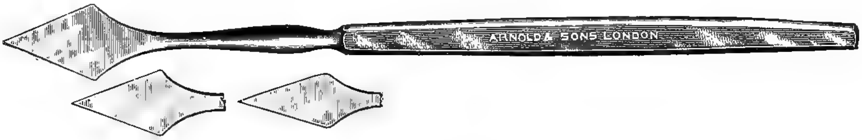

Fig. 176.—Keratome.

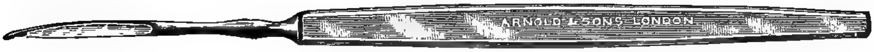

Fig. 177.—Weber's knife.

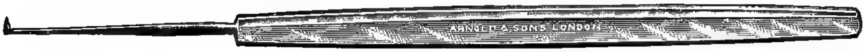

Fig. 178.—Cystotome.

Operations for Cataract.—In partial cataracts which present at the pupillary area an *iridectomy* (*q.v.*) may afford some degree of sight, but it is of very doubtful value in the horse because of the limitation of the eye movements in that animal. In the dog the operation may give quite useful results. In the case of a diffuse cataract it has to be considered whether any appreciable improvement of sight will be afforded by the removal of the lens. In animals it is obviously impracticable to bring about restoration of sight by the habitual use of glasses. On the other hand, an animal totally blind from cataract will be benefited even by the very imperfect vision afforded by the operation alone. After the removal of the lens, provided the fundus of the eye is normal, an animal blind from cataract may be expected to see sufficiently well to avoid collision with objects in his path.

The *time of the operation* is decided in accordance with the condition of the cataract. If this is immature, then the unripe cortical portions are likely to be left behind when the attempt is made to remove the lens. When mature, the lens can be extracted entire without difficulty. If the cataract is allowed to go on to the stage of hypermaturity the cortical substance may either become fluid or it may dry up and harden, whilst the capsule is likely to become thickened. In neither case is it so favourable for operation.

Discission, or the needling operation, is one of the simplest procedures. It consists in scratching and opening the anterior capsule of the lens so as to allow the aqueous humour to infiltrate the lens substance, so bringing about the breakdown, solution, and absorption of the lens fibres. The cataract should be mature before the operation is undertaken, as the disintegration process then occupies a shorter time. Similarly, the larger the opening in the capsule the shorter the time for solution and absorption of the lens. Only a moderate opening should be made at the first operation, but it may, if necessary, be repeated.

The animal is anæsthetized, a speculum applied, and the eye fixed with fixation forceps. The needle is entered under the conjunctiva a few millimetres outside the corneo-scleral margin, then at the margin turned into the anterior chamber. The point of the needle passes across the chamber to the lower edge of the pupil, then is inserted into the lens capsule, and a vertical incision is made in the capsule. The needle is then withdrawn and a little aqueous humour escapes with it. To prevent any prolapse of the iris atropine is to be instilled before the operation, and its use continued until absorption is complete.

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[1] See "Anæsthesia for Eye Operations," p. 743.

Discission answers best in young animals, when the lens nucleus is not too hard, and the tendency to iritis not serious. Strict asepsis is essential to success. In some cases increased intraocular tension has been observed following the operation, owing to swelling of the lens blocking the canal of Schlemm. Iritis may occur because of the irritation due to particles of the disintegrating lens.

Extraction of the Lens.—Several operations have been devised for the extraction of the cataractous lens, and each has some special advantage under differing circumstances. Only one operation will be described here, and readers desiring detailed information of the other methods available are advised to consult works on diseases of the eye in human surgery.

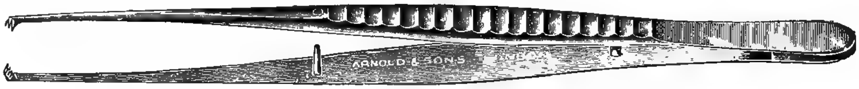

FIG. 179.—Fixation forceps.

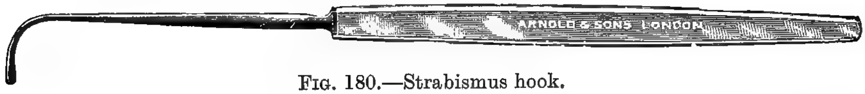

FIG. 180.—Strabismus hook.

FIG. 181.—Von Graefe's knife.

The operation here described consists of the following stages: corneal incision, incision of the capsule, presentment and removal of the lens, and the toilet of the part. A further step, that of iridectomy, may in some cases be practised with advantage prior to the incision of the capsule. After anæsthesia has been secured, the conjunctiva disinfected, and speculum and fixation forceps applied, the corneal incision is made in a similar manner as that for iridectomy, either with or without a conjunctival flap. Using a Graefe's cataract knife, the point should be inserted just outside the corneo-scleral margin, the knife made to traverse the anterior chamber and make its exit at the corresponding point on the opposite side of the cornea—the entrance and exit being at such a level as to leave about one-third of the cornea above the line joining them. An upward incision is then made so as to leave a flap of cornea. Cutting through the corneal substance, the blade is seen to lie subjacent to the bulbar conjunctiva, and the incision can be continued so as to leave a conjunctival flap. Aqueous humour escapes as the knife is being withdrawn. The capsule may be incised by means of a cystotome or capsule knife, or torn by means of special forceps.

Major Henry Smith, of the Indian Medical Service, practises and advocates a method of extraction of the lens in its capsule. This, when successfully accomplished, is undoubtedly the ideal method of extraction, but there is very considerable danger, during the manipulation necessary to press out the lens, of prolapse of the vitreous. The cystotome is introduced through the corneal incision, across the anterior chamber to the lower edge of the pupil, and then is turned with its edge towards the capsule, and two incisions, one up and outwards, one up and inwards, like the arms of a V, are made in the capsule. A transverse incision is then made joining the former two at the top.

The lens is now made to present at the corneal incision by pressure being applied with a spatula just below the lower edge of the cornea. When the upper end of the lens tilts forwards into the incision the spatula is gradually moved up over the cornea and the lens gently pressed out. The extraction at this stage can be assisted by the use of a spoon or forceps to grasp the lens as it escapes through the wound. Great care must be taken to avoid rupture of the suspensory ligament, or prolapse of the vitreous, or prolapse of the iris.

The last stage consists in seeing that the pupil is clear, and that particles of the cortex have not been left behind; in seeing that there is no prolapsed iris in the wound; and that blood-clots are removed and the flap evenly laid down. The conjunctiva is then flushed with normal saline solution, and the dressing of sterilized lint and gauze is fixed with a lightly applied bandage. The eye should not be dressed again for forty-eight hours, and then only gently irrigated, after which a drop of atropine solution is instilled and the dressing reapplied.

Iridectomy before incising the capsule has for its object the prevention of prolapse of the iris. This prolapse is not so likely to occur during the operation as at some time during the first two or three days, before the corneal incision has healed. The aqueous humour within a few hours of the operation may have been replaced, and with some sudden effort on the part of the patient, such as a cough, the pressure is then enough to force aqueous humour out through the corneal wound, carrying with it a portion of the iris. An iridectomy with only the narrowest coloboma is sufficient to prevent this prolapse, and it is an advisable part of the cataract operation.

Dislocation of the lens may be a congenital defect, or it may result from injury such as a blow on the eye, or as a consequence of a perforating wound of the cornea and escape of the aqueous humour and prolapse of the lens. The dislocation may be partial or complete, and it may take place into the anterior chamber or into the vitreous. With either partial or complete dislocation the refractive power of the eye is quite abnormal.

Treatment.—Complete dislocation into the anterior chamber usually calls for operative extraction because of the irritation set up.

Dislocation of the cataractous lens due to hypermaturity is not uncommon. The chalky mass acts as an irritant if in the anterior chamber and requires removal. Sometimes the cataract is very friable and disintegrates readily when the extraction is attempted. Forceps or a spoon may have to be used after the cornea has been incised, and all remaining particles should be flushed out by means of an irrigation of warm normal saline into the anterior chamber.

XII. Diseases of the Retina and Optic Nerve

Retinitis is a very rare disease in the domesticated animals, and this is not surprising when it is understood that disease of the retina in man is almost always due to constitutional or general disease rather than to any local abnormality in the eye. The main causes of retinitis in man are *syphilis*, which does not occur in animals; *nephritis with albuminuria*, *diabetes*, and *leucœmia*, none of which are common in animals. Cases have been recorded in horses following influenza and contagious pneumonia, but they are very rare.

In all these cases the retinitis usually affects both eyes. The chief signs on ophthalmoscopic examination of the fundus are a general cloudiness of the retina, marked congestion of the vessels, and a blurring of the outline of the optic disc. After a time there is exudation and often hæmorrhage from the congested vessels.

Treatment.—There is no satisfactory treatment for *retinitis.* If a general systemic disease is responsible, treatment of the underlying cause may relieve the eye disease.

Retinal Hæmorrhage is a condition not uncommon in man because of the liability of man to disease of the arteries. It is, however, a very rare thing to find arterial disease in the lower animals, and retinal hæmorrhages are equally rare.

Tumours of the Retina

See "Tumours of the Eye," p. 774.

Diseases of the Optic Nerve

Optic Neuritis.—*Inflammation of the optic nerve* is a very uncommon disease in animals. In man it is usually caused by some disease of the brain, especially a brain tumour. Other causes are cerebral abscess, meningitis, especially the tubercular type, sometimes subdural hæmorrhage or fracture of the skull.

In all these cases there is an increase of intracranial pressure, and this, acting on the optic nerve fibres coming through the *lamina cribrosa* at the back of the eye, leads to venous congestion, and œdema in the nerve. Subsequently there is formation of a new connective tissue and consequent atrophy of the nerve fibres. The appearance to the ophthalmoscope in the earlier stages is that known as "*choked disc*," the disc being swollen or even dome-shaped, the veins greatly distended and tortuous, whilst the arteries are contracted.

Other causes of optic neuritis are inflammatory processes in the orbit, such as cellulitis or abscess. The condition may also occasionally follow the acute febrile diseases influenza and pneumonia in the horse, and distemper in the dog.

When the congestive stage goes on to *Optic Atrophy* from pressure of exudate and new connective tissue around the nerve fibres, the appearance of the optic disc changes. The congestion of the vessels passes off, and the disc itself becomes greyish-white in colour, and flattened. With optic atrophy blindness comes on.

Treatment.—There is no useful treatment for cases of optic neuritis or atrophy except to remove the underlying cause at an early stage if it can be discovered.

Amaurosis, Ambylopia

Amaurosis is the term applied to a state of blindness usually without any obvious lesion to account for it.

Amblyopia or dimness of vision is a condition which may precede amaurosis, and the causes of the two are similar.

Cases of unexplained partial or complete blindness occurring more or less suddenly and usually affecting both eyes are seen in all animals, especially horses, cattle, and dogs. The number of such cases is becoming fewer with increased knowledge of the pathology of eye diseases, and so the term amaurosis is being used less than formerly.

Symptoms.—The animal shows the usual signs of defective sight, running into stationary objects, and showing the uncertain gait and hypersensitive ear movements of a blind animal. The condition may come on gradually, but more often arises suddenly or is not noticed until blindness is almost complete. On examination the pupil is found widely dilated, and the eye has a fixed, glassy look. The pupil does not react to light stimuli. Ophthalmoscopic examination often reveals nothing abnormal.

Causes.—Amaurosis may be toxic in origin, and this is probably the cause in the majority of cases. Certain drugs given in toxic doses affect the retina, probably by their effects on blood pressure and the blood supply of the part, and so produce temporary or sometimes permanent blindness with widely-dilated pupil. The drugs commonly responsible are *quinine*, *filix mas*, and *areca nut*, and the condition is especially liable to occur in the dog. Poisoning with *lead* will cause the same condition. In man excessive use of alcohol and tobacco may lead to a similar result.

Amaurosis may also be seen as a symptom in some cases of *meningitis*, also in *epilepsy*. A temporary amaurosis may occur after profuse hæmorrhage.

The condition may occasionally be unilateral, in which case it is likely to be due to local disease of the retina or optic nerve of that side, or a brain lesion, rather than to a constitutional disease.

Treatment.—If the condition is toxic in origin the first step is to stop the administration of the responsible drug. A purgative should then be given, followed by treatment with tonics as digitalis or strychnine. Inhalations of amyl nitrite often give temporary relief and may be repeated frequently.

Where alterations in the structure of the retina or optic nerve have taken place, treatment is of no avail.

XIII. Displacements of the Eyeball

Exophthalmos or **proptosis** is a condition in which the eyeball bulges more or less, and is therefore too prominent, as in certain breeds of dogs, notably pugs, Japanese and Pekinese spaniels. In other breeds the eyeball is normally prominent, and in other animals prominence of the eyeball is abnormal. The condition may result from the pressure of an orbital tumour, or an abscess, or from cellulitis or emphysema in the connective tissue in the orbit. Marked œdema of the eyeball (see "Glaucoma") may make the globe over-prominent, or hæmorrhage or pus formation into the eyeball may produce the same appearance. In the dog and cat the orbital salivary gland is in contact with the periorbital structures just deep to the lower eyelid. Abscess of this gland occurs in the dog and cat and leads to marked proptosis.

Treatment.—In cases of cellulitis, or abscess, fomentations must be applied, and the ordinary surgical procedure for the early evacuation of pus and general treatment of septic conditions must be followed. Glaucoma, hæmorrhage, or pus formation in the eyeball necessitates special treatment, which has been described elsewhere in this chapter.

Exophthalmic goitre has been recorded in the horse, ox, and dog. The condition arises from over-secretion of the thyroid gland and is characterized by some degree of exophthalmos or proptosis, by enlargement of the thyroid gland, and *tachycardia* (*i.e.* frequent pulse). In addition to these characteristic symptoms there may be in the dog vomiting and diarrhœa with irregular appetite, and in the horse excitement and nervousness.

Treatment.—Radical treatment consists in lessening the amount of thyroid substance absorbed by partial excision of the thyroid gland.

Strabismus, or "squint," is a rare condition in animals. From want of co-ordination, or of balance in the pull of the orbital muscles, the eye is deflected and the visual axes of the two eyes do not meet at the object looked at. The squint may be due to overaction of one muscle or to paralysis of the opposing muscle. The eye may be deflected outwards, *i.e.* divergent squint, or inwards, *i.e.* convergent squint, this being much the more common. Vertical or oblique deflections are much rarer. Hobday has recorded cases in the dog,[1] and these are not very rare. Clive Webb recorded one in a mule.[2]

Causes.—The condition may be due to *paralysis* of one or more of the ocular muscles as a result of a lesion (1) in the orbit, (2) in the brain. The lesion in the orbit may be a fracture, or a wound, or an abscess, involving either the muscle itself or the nerve supplying it. The lesion in the brain may be a neoplasm, or meningitis, or the result of an injury such as fracture of the skull, or it may be part of a systemic disease such as rabies, with paralysis of certain muscles as a characteristic symptom.

On the other hand, strabismus may be due to the overaction of one or more of the ocular muscles, generally as the result of hypermetropia or, less commonly, myopia, the patient making an attempt to correct for the difficulty in accommodation in the abnormally refracting eye.

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[1] *Surgical Diseases of the Dog and Cat*, 2nd edition, p. 107.

[2] *Journal of Comparative Pathology*.

Treatment.—In the paralytic cases due to orbital disease, the treatment of this latter condition may relieve the squint. If due to a brain lesion there is no treatment likely to be of any avail. Strabismus due to overaction of a muscle may be relieved or cured by either (1) dividing the overacting muscle or (2) advancing the point of insertion of the less active muscle so as to shorten it.

The eye is anæsthetized by an instillation of cocaine and by an injection of a few minims of a 1 per cent solution under the conjunctiva just over the insertion of the muscle to be divided. The speculum is inserted, fixation forceps applied, and an incision made in the conjunctiva over the insertion of the muscle with scissors. Probe-pointed scissors are inserted into this incision and the subconjunctival connective tissue divided so as to free a passage for the strabismus hook to beyond the insertion of the muscle. The hook is passed under the muscle and drawn forward close up to its insertion into the sclerotic. One blade of the scissors is now passed in between the hook and the globe and the tendon is divided. It is important to see that all the width of the tendon has been divided, otherwise the operation will probably be unsatisfactory.

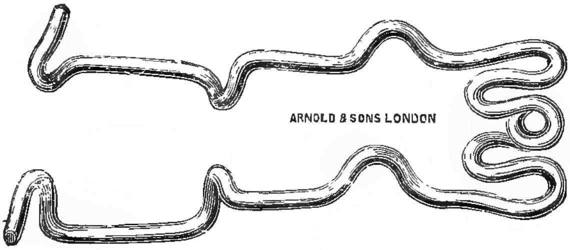

FIG. 182.—Eye speculum.

Nystagmus is a condition in which there is an oscillatory motion of the eyeball when the animal attempts to look at an object. The condition prevents the eyeball coming to rest at once when it is turned on to an object. Instead it moves rapidly to and fro several times before settling down. The movement is quite involuntary and is usually in the horizontal direction. It is due in the majority of cases to cerebellar or vestibular disease, with consequent inco-ordination of the ocular muscles; or to hysteria, eclampsia, and such conditions. It is also seen commonly in cases of albinism, and this again is associated with errors in refraction.

There is no treatment to be advised for nystagmus.

Dislocation of the Eye.—*Dislocation* or *prolapse* of the globe occurs generally as the result of trauma. It is said to be produced sometimes as the result of pressure from growing tumours in the orbit behind the eye. In carnivora, particularly in dogs of the pug, bulldog, and Pekinese and Japanese spaniel breeds, comparatively slight injuries can dislodge the globe anteriorly from the orbit. The incompleteness of the bony orbit in carnivora no doubt lends itself to the occurrence of the accident.

In the horse dislocation is rare, except as a result of fracture of the orbit.

The condition is a distressing one, as much pain and damage to the delicate structures of the eye accompany the prolapse. The lids are usually found fixed behind the globe, with marked congestion of the exposed conjunctiva and often tearing of muscle fibres. The appearance of the globe will depend upon the length of time since the prolapse occurred. The cornea soon becomes dry and opaque, and a great increase of intraocular tension is probably present in all cases, on account of the strangulation produced by the tight lid margins. If the dislocation is of more than a few hours' duration the congestion and œdema may be such as to render reduction impossible. Further, the effects of the strangulation are often so serious as to render the eye useless, even if the attempts at reduction are successful.

Treatment.—The sooner attempts at reduction are commenced after dislocation the greater the chance of easy reduction and restoration of normal sight. The animal should be put under morphine, the eye cleansed by irrigation with normal saline or by means of wet swabs, and then lubricated with sterile glycerine. A large piece of gauze folded several times is then wrung out of saline solution and used to envelope the eye so as to obtain equal pressure from all sides. The congestion may often be greatly reduced by fomenting the eyeball with sterile water containing ice for a quarter of an hour before attempting the reduction.

It may be necessary to enlarge the palpebral fissure by snicking the rim of the orbicularis at the outer canthus, and some surgeons recommend puncture of the anterior chamber to relieve the tension, but the advantage in most cases is doubtful. To prevent recurrence while the parts are stretched, the lids may be sutured together, or else closed by adhesive strapping, while hot packs may be applied to the eye for the relief of pain. It has been our experience, in most cases where prolapse has occurred more than a few hours before replacement, that the sight is permanently impaired if not lost.

Congenital Deformities of the Eye

Anophthalmos.—True anophthalmos, *i.e.* complete absence of any representative eye structure, is unknown. The name is usually applied to that form not uncommonly found in foals and puppies where no fully-developed eyes are present. It may be unilateral or bilateral. The palpebral aperture and the orbit are small, and the globe of the eye is represented by a small pigmented cyst to which are attached the rudimentary ocular muscles.

Microphthalmos is a condition in which the eye is small, the ocular cleft having failed to fuse during development. A cyst is usually present, which may occasionally develop into a large cystic mass if the animal is allowed to survive.

Treatment.—Anophthalmos and microphthalmos are not capable of treatment, but a condition in which there is an eye smaller than normal but still capable of sight is not uncommon in puppies. Often the membrana nictitans overlaps the small globe and protrudes somewhat. The prominent membrana should be removed, and any opacity of the cornea which it may have caused should be treated.

Cyclops.—Fusion of the orbits gives rise to a condition known as *Cyclops*, usually only seen in fœtal monsters. A cyclops horse not otherwise deformed has, however, been known to reach maturity.

Ankyloblepharon, or fusion of the lids, rarely occurs as a congenital condition. In dogs and cats a temporary state of fusion exists for the first few days after birth. In cases where the union persists, the lids should be divided along the palpebral margin, care being taken to prevent reunion by stitching the conjunctiva to the lids at the line of incision and anointing the parts with vaseline.

Blepharophimosis is the term applied to a small palpebral aperture which occurs as a congenital deformity. It is not infrequently seen in puppies (see "Entropion").

Treatment consists, as stated, in performing a canthoplastic operation.

Congenital opacity of the cornea is occasionally seen in the form of whitish areas tending to clear up spontaneously. Other congenital abnormalities are *persistent pupillary membrane*, *congenital cataract*, and *dislocation of the lens*, but they are rare and unimportant.

XIV. Tumours of the Eye and its Appendages.

In describing the tumours affecting the eyes of animals and their treatment it is convenient to group them together rather than discuss them under the diseases of each separate structure. In animals the commonest tumours are those of the eyelids, including the membrana nictitans, of the conjunctiva, the caruncle, and the glands within the orbit. The skin covering the eyelids is not uncommonly the starting-point of papilloma in the horse, and fibroma, or even the malignant epithelioma and sarcoma, may originate there. Such, however, are not eye tumours proper and only affect or invade the eye secondarily. When they are seen, however, their possible effects on the eye should be borne in mind with a view to their removal if necessary before such effects are produced.

The conjunctiva, palpebral or bulbar, may be the point of origin of a number of benign tumours. A **fibroma** may sometimes be seen growing from the palpebral conjunctiva, and so coming to lie between the eyeball and the lid. Because of this position the tumour is usually flattened and may be pedunculated. By pressure and local irritation of the cornea it may cause opacity, and also produce deformity of the eyelid. The treatment of this growth is early excision.

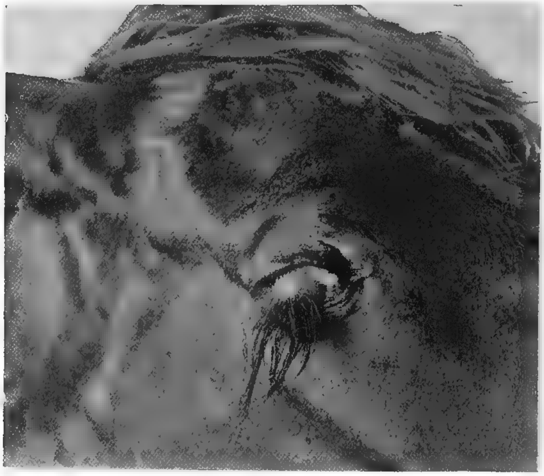

FIG. 183.—Dermoid.

Another rather rare tumour of the conjunctiva is a **lipoma,** occurring as a lobulated mass of fat between the ocular muscles, subjacent to the conjunctiva. This is a congenital tumour, and may require to be removed if by increasing growth it causes pressure on the eyeball and strabismus or exophthalmos.

Dermoid.—Commoner than the above is the growth known as **dermoid** (Fig. 183). This is often congenital, and it is found as a small, smooth, fleshy-looking, flattened mass generally growing from the conjunctiva at the corneoscleral margin. In structure it is more or less like the normal skin, with the same complex histology. Thus it consists of dense vascular connective tissue containing glands, fat, and sometimes muscle fibres, and covered with stratified epithelium. From its surface in many cases grow more or less numerous hairs (Fig. 183), and the surface epithelium does not undergo any horny change, but the cells remain soft and swollen due to the constant action of the lachrymal secretion. Dermoids are most commonly seen in the dog, but also not infrequently in the ox.

Symptoms.—The growth is a continuous source of irritation, and so causes lachrymation and increased annoyance by flies. It may show a tendency to spread over the cornea and so interfere with vision.

Treatment.—The tumour should be removed by careful dissection from off the cornea and sclera after the instillation of cocaine and adrenalin.

Two other outgrowths from the conjunctiva may be mentioned here, viz. pinguecula and pterygium.

Pinguecula is a small, yellowish elevation on the bulbar conjunctiva near the corneal margin. It consists, not of fat as its name implies, but of connective tissue chiefly, and is probably due to irritation by dust or other foreign bodies. No treatment is called for unless the growth becomes large enough to act as an irritant, when it may be snipped off.

Pterygium is a vascular thickening of the conjunctiva, triangular in shape, with its base at the inner or outer canthus and its apex on the cornea. The neck of the growth stretches across the limbus of the cornea, and its upper and lower edges are limited by slightly overhanging folds. The origin of a pterygium is somewhat doubtful, but probably many cases are simply developments from pingueculæ. In the early stages the mass is thick and vascular, but when old it becomes thin and pale. If the growth shows a tendency to extend across the cornea it must be removed, otherwise it is only a blemish. Removal is best done by means of multiple ligatures. Using two needles, the growth is transfixed by one near the base, and by the other near the apex. The silk is then cut near the eye of each needle and the three ligatures are then tied, one including the apex, one the base, and one the central portion of the growth.

False pterygium, or pseudo-pterygium, is the name given to a strand of conjunctiva which is sometimes seen stretching across from the bulbar conjunctiva outside the limbus to the middle of the cornea after the healing of a corneal ulcer. This is simply due to the adhesion of a loose bit of conjunctiva to the corneal wound, and a corneal leucoma forms at the point of attachment. That the neck of the strand is unattached can be shown by passing a probe through behind it. The growth is best removed by applying two ligatures—one round the base and one round the apex. The leucoma may afterwards be lessened in extent and thickness by the use of the silver nitrate stick.

Papilloma must be reckoned a fairly common tumour of the conjunctiva in horses and cattle where the membrana nictitans is well developed. It may begin from the conjunctiva at the corneo-scleral margin, but more often originates on the anterior or outer surface of the membrana (Fig. 184). In these animals there is considerable reason to think that irritation, whether by flies or by sand, is a factor in the causation. Whilst the tumour is rare in Great Britain, it is distinctly common in parts of Australia. Evelyn Place has recorded cases in which the embryos of nematode worms carried by flies have been discovered in sections of tumours removed from the membrana nictitans.[1]

The tumour may extend so as to obstruct the cornea or cause an opacity, or it may exert pressure on the eyeball. Further, clinical observation indicates that papillomata may take on malignant characters. For these reasons early excision of the growth is to be advised in every case.

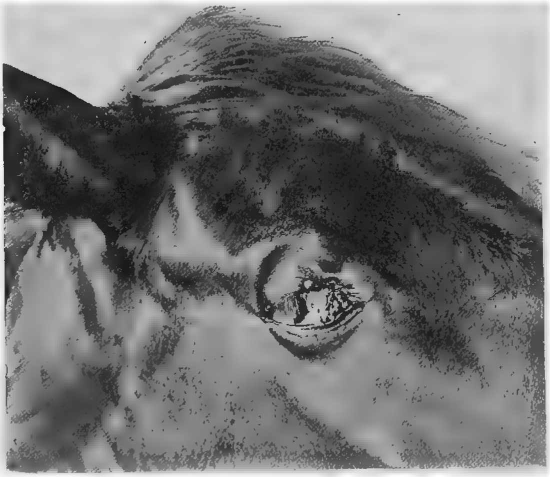

FIG. 184.—Papilloma.

More important and commoner than these benign tumours are various forms of malignant growth.

Epithelioma or **squamous-celled carcinoma** is probably the commonest of all tumours of the conjunctiva. It may begin in rare cases near the corneo-scleral margin from the bulbar conjunctiva, usually presenting at first as a small nodule covered with distended blood-vessels. Much more commonly in horses and cattle the growth starts on the membrana nictitans (Fig. 185). In many cases there is a history, more or less reliable, of an injury to the eye prior to the appearance of the growth. In other cases irritation by flies or by sand may be a factor, for these growths are much commoner in countries such as Australia and New Zealand, where these factors operate, than in England.[1]

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[1] See "Parasites affecting the Eye," p. 777.

The epithelium becomes thickened, the warty-looking growth enlarges, usually rather slowly, and becomes ulcerated. It then easily bleeds, and if left untreated spreads to neighbouring structures. The caruncle, puncta, and lachrymal sac are invaded in many cases, and the duct obstructed so that tears flow over the face. The eyeball is also infiltrated and destroyed, or, if not actually invaded, is pressed upon and displaced by the fungating mass which eventually fills the orbital cavity. Often the eyelids and in many cases the lachrymal bone become involved. The malignancy of these growths varies considerably in different cases. In cattle the neighbouring lymphatic glands, parotid and submaxillary, are not commonly affected until the tumour has attained a large size. In the horse metastatic involvement of the glands appears to take place earlier, and recurrence after excision is very liable to occur unless in the very early stages of the growth.[2]

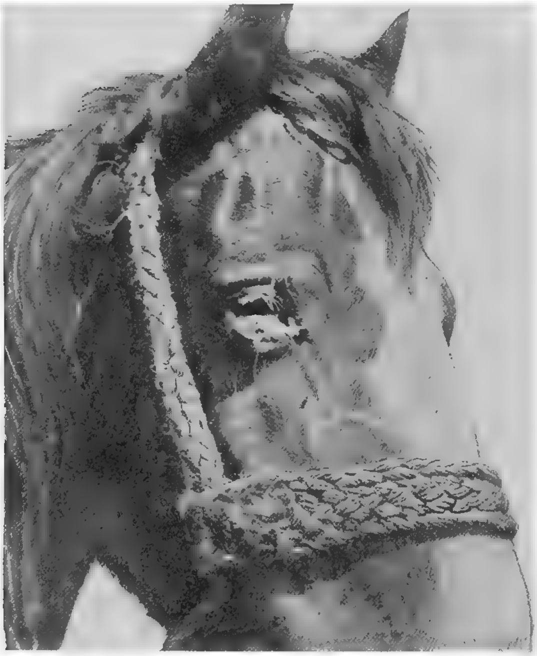

FIG. 185.—Epithelioma.

Carcinoma may also originate from the eyelids or from the lachrymal or other glands in the orbit, but such are not so common. Cleland records a case of epithelioma from the conjunctival surface of the lower eyelid in the horse "originating probably in one of the gland appendages of the skin."[3]

Treatment.—Excision at the earliest possible moment is the only treatment for epithelioma. When the membrana is the seat of origin, the excision is easy, and if done when the growth is quite small is likely to be followed by a radical cure. Where other structures in the eyeball are involved, the whole globe with the membrana should be removed. When the lachrymal ducts and sac, and sometimes the lachrymal bone, are invaded, an extensive and difficult operation is called for, and recurrence of the growth is almost certain. Usually in these advanced cases the animal has to be destroyed.

Sarcoma rarely arises from the conjunctiva, although pigmented, small, round-celled, or more rarely spindle-celled, sarcoma are occasionally seen beginning at the corneo-scleral margin, or down in the fornix. Such growths are rounded, black or brown in colour, sometimes lobulated, and very vascular. They do not ulcerate as a rule, although they may break down as a result of interstitial hæmorrhage and degeneration. Usually they are smooth, shiny, and covered by an epithelial layer.

Sarcoma of the orbit, whether of the bone or neighbouring connective tissue layers, is much commoner, but may lead to marked displacement of the eyeball, causing proptosis, exophthalmos, and ultimate destruction of the eye.

Sarcoma originating *in the choroid* is the commonest intraocular tumour. It may be of the pigmented (melano-sarcoma) or non-pigmented type. As the growth increases intraocular tension rises, the vitreous often becomes opaque, and soon either cornea or sclerotic is invaded and perforated, revealing an irregular greyish mass. The tumour by now fills the orbital cavity so that the eyelids are tightly stretched over the globe. It usually breaks down at one or more points because of hæmorrhage into its substance, and discharges an offensive sanious matter. The skin of the eyelids and the bones of the orbit are often invaded, and secondary growths occur in other organs, as the liver or lungs.

The diagnosis of choroidal sarcoma is difficult, but since blindness is caused at a fairly early stage, and the globe is becoming increasingly tense and too large for the eyelids to close over it, extraction of the eye is indicated. If this is done promptly, the progress of the disease may be stopped before secondary deposits have occurred.

Melanosis Oculi.—The iris or other parts of the eye, conjunctiva, sclera, or choroid may sometimes contain areas of deep pigmentation like pigmented moles of the skin. Such may be the starting-point of malignant new growths of the melanotic sarcomatous type.

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[1] See *New Zealand Department of Agriculture Annual Reports* (Division of Veterinary Science), 1900 and 1901.

[2] "Carcinoma of Membrana Nictitans," McFadyean, *Journal of Com. Path.* vol. xvii. p. 352.

[3] *Ibid.* vol. xxi. p. 242.

Endothelioma is another tumour, of a low type of malignancy in most cases, which may be found in connection with the eye or orbital cavity. It is often encapsuled and slow-growing, showing little tendency to recur after excision. A case, apparently of this type, is recorded by Gilruth.[1] On the other hand, cases occur in which an endothelioma shows rapid growth, an infiltrating habit, and all the signs of malignancy. In one such case seen by the writer in a horse there was a large fungating mass originating apparently from the conjunctiva or the membrana. The growth caused eversion of the upper eyelid and atrophy of the eyeball. Because of this possibility the general rule of early excision of the membrana or of the eyeball from which the growth commences should be observed.

Glioma is a rare tumour which originates in the retina. It occurs in the human subject, and no record of a case in animals has come under notice. The growth pushes forward the retina, and then invades the eye. The neighbouring glands may be involved and secondary growths are sometimes found in the liver.

Intracranial Tumours.—Although unrelated to tumours of the eye and its appendages, it is of interest to mention the effects of intracranial tumours on the eye. Any tumour growing inside the cranium necessarily causes an increase of intracranial pressure. The *lamina cribrosa*, *i.e.* the perforated plate of the meninges through which the optic nerve makes its exit from the skull into the orbit, is one of the weak places in the cranial wall, and one effect of increased pressure is to cause a bulging of this membrane and pressure on the optic nerve-fibres coming through it. The result is that in a large percentage of intracranial tumours, whether of the brain, meninges, or bones, there is interference with vision. Especially is this the case with tumours of the cerebellum. The characteristic sign, visible only by means of the ophthalmoscope, is that known as "choked disc" in which the disc is greatly swollen and prominent, the veins in it being distended from back pressure, whilst the arteries are compressed. If the animal lives more than a very short time, complete optic atrophy and blindness result.

XV. Parasitic Affections of the Eye

The parasitic diseases of the eye are few in number. The *skin* of the eyelids may be affected with skin parasites as in the various forms of mange, infection with lice, ticks, and flies. Similarly the parasitic fungi causing ringworm very frequently attack the skin about the eyelids. These various parasitic conditions of the skin do not concern the eye proper except in so far as they set up irritation, and so lead to rubbing and scratching of the eyelids. By this means damage may be done to the eyelids, causing distortion or scarring, and so entropion or ectropion may be produced. Or the conjunctiva may be infected and conjunctivitis set up; or the cornea may be abraded or wounded, with serious results to the eye. For this reason the treatment of parasitic disease of the skin about the eyelids is a matter of concern to the ophthalmic surgeon. These parasitic diseases have to be distinguished from eczema of the eyelids, which also is important because of the irritation it sets up and the damage it may cause.

There are other parasites which occasionally find a locus in the eyes of animals, such as *Hæmopis sanguisuga*, the leech; and possibly the larvæ of *Hypoderma*. Again, the parasites which involve muscles such as *Trichinella spiralis*, *sarcosporidia*, and various *Cysticerci* may occasionally invade the ocular muscles. All these are rare—*Cysticercus cellulosæ*, the pig measle, being the one most often recorded. In the human subject cysticerci have been recorded fairly often subjacent to the retina and sometimes subjunctival, and one or two cases of this aberrant parasite have been recorded in animals.

There are, however, a number of parasites belonging to the nematode worms and of the family Filariidæ which affect the eye, inhabiting either the conjunctival sac, so setting up verminous conjunctivitis, or invading the globe of the eye, so producing more or less diffuse ophthalmia.

Verminous conjunctivitis or extraocular filariasis is most commonly seen in the horse and ox, more particularly in the latter, in which animal the condition is described as fairly common in the south of France. A similar condition has been described by Dale as occurring in the dog in the Punjab (due to *Kelazia collipædia*); by Lees in the camel in India (due to *Kelazia Leesi*); and by Cobbold and other writers in the fowl in China (due to *Filaria Mansoni*). The condition in animals other than the horse and ox is a somewhat rare one, and differs little from that described for the horse and ox.

In the horse verminous conjunctivitis is a rare disease, and even when parasites are present, either beneath the eyelids in the conjunctival sac or in the lachrymal canals, symptoms may be so slight that the condition is unsuspected until it is specially looked for. In some cases, however, there is marked conjunctivitis, with epiphora, photophobia and tenderness, and these may be followed by keratitis and permanent opacity of the cornea. The causal parasite is *Kelazia lachrymalis* (vel. *Filaria lachrymalis* vel. *F. palpebralis*), the male being 8-12 mm. and the female 14-18 mm. long. Usually only two or three worms are found under the lids, but sometimes a large number. The same parasite may invade the anterior chamber of the eye, setting up ophthalmia. The mode of infection is unknown.

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[1] *Veterinary Journal*, 1910, p. 486. Recurrence in this case did eventually take place, and when the animal was destroyed there were large secondary growths in the parotid and submaxillary lymph glands.

In the ox the condition is more common than in the horse, and it is especially prevalent in the south of France and in Belgium. Epidemics of the disease have been recorded in France, occurring in the late summer and autumn. Three species of parasites have been implicated : *Kelazia Rhodesi, T. gulosa*, and *T. alfortensis.* As in the horse, so in cattle, the parasites are usually confined to the conjunctival sac, often under the membrana nictitans, but they may invade the anterior chamber of the eye. The symptoms are the same as in the horse, and from conjunctivitis there may be extension to the cornea with the possibility of ulceration.

Treatment consists primarily in the removal of the worms, using a soft camel-hair brush. It is necessary afterwards to irrigate the conjunctival sac thoroughly to remove any debris of worms or ova, and also the products of inflammation, with 1 in 2000 sublimate solution, or silver nitrate 1 to 2 grains to 1 ounce of water. For further treatment of the conjunctivitis and any complications see "Conjunctivitis," p. 755.

Habronemic Conjunctivitis.—Quite recently a condition has been observed in Victoria in which there is a chronic thickening of the conjunctiva together with some eversion or distortion of the lower eyelid, or sometimes prominence and thickening of the membrana nictitans. On close examination numerous minute yellowish white points can be seen embedded in the conjunctiva lining the lid and right down into the fornix, and also in that covering the surface of the membrana. Sections of the thickened membrane microscopically examined show that the yellowish points are areas of necrosis often surrounding the dead embryo of a parasite, one of the Habronema species. There is some evidence that the parasite is introduced by a biting fly.

Treatment.—If seen in the early stages, before much thickening or growth of granulomatous tissue has occurred, the use of silver nitrate solution to promote an acute inflammatory reaction is probably all that is required. If overgrowth of tissue has occurred, its removal may be necessary by operation.

Verminous Ophthalmia, Intraocular Filariasis, "Worm in the Eye."—This condition is seen in both horses and cattle, much the more commonly in the former.

In the horse the disease occurs fairly frequently in India, from Ceylon to Burma, and it has been described by several writers, notably Lingard.[1] Cases in Europe and America are now rare, although epidemics have been recorded in France and Belgium. The causal parasite has been variously named. Rivolta considered it an immature form of *Filaria equina* or *papillosa*, whose common habitat is the peritoneal cavity. Cobbold adopted the same view. This is probably incorrect, and the fact that *F. equina* may be found not uncommonly in the peritoneum of horses in various parts of the world where ocular filariasis is unknown is evidence against this view. Thus the question as to whether *Filaria oculi*, as the parasite is most commonly named, is a distinct species must be considered still undetermined. The worm is thread-like and generally white or sometimes pigmented, with an average length of 24 mm. (Lingard) and a width of about 300 mm.

Symptoms.—These are due to the worm acting as a foreign body. There is lachrymation, twitching of the eyelids, photophobia, and conjunctivitis in the early stages. Then the iris becomes inflamed, the aqueous humour tends to become turbid, and the cornea opaque. The opacity is diffuse and at first thin and nebulous, but shortly the cornea becomes thickened and a streaky dense opacity results. With movements of the parasite from the front to the back of the iris an early corneal opacity may clear up, but only temporarily.

Mode of Infection.—This is not definitely known. It is possible that the ova of the parasites may have been introduced by flies, or through the agency of water, or from hay, lucerne, dry grass, or other food materials. Animals from Australia, where the condition is unknown, introduced into those parts of India where the disease is most prevalent, have been found affected commonly within twelve months of their arrival in the country.

Treatment must be undertaken as soon as the condition is diagnosed, since operation is much easier whilst the cornea is still transparent. The eye is thoroughly irrigated with boracic acid solution or sterile saline solution, and then anæsthetized with a solution of cocaine, atropine, and adrenalin. The horse may be operated on whilst standing, or preferably when cast. A speculum is used to keep the lids open, fixation forceps applied, and an incision made through the cornea in the lower and outer quadrant close to the corneo-scleral margin with a small lancet. The aqueous humour escapes and carries out the worm with it, so that it can be seized with forceps. A further irrigation of the eye with boracic acid or saline solution and the application of a cold compress completes the operation.

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[1] "Ocular Filariæ," *Journal of Tropical Veterinary Science*, vol. i. p. 175.

The only further treatment is addressed to the removal of the corneal opacity and relief of the conjunctivitis, if any.

In cattle, similar symptoms result from intra-ocular invasion as in the horse, and the same treatment is required.

XVI. Diseases of the Orbit

The bony socket and its contents outside the globe of the eye may be involved in various diseased conditions which will have a more or less direct effect on the eye.

Injuries of the bony rim of the orbit and fractures involving its walls may affect the various nerves coming through the foramina. With compound fractures infection of the soft tissues is likely to occur, and cellulitis or abscess formation or emphysema may result. Blows on the eye may cause marked contusion of the structures in the orbit, with effusion of blood and sometimes suppuration later.

Cellulitis of the Orbit.—Cellulitis of the orbit is an inflammatory condition which may arise from an extension of some sepsis in the vicinity of the orbit, as in the supra-orbital fossa or neighbouring sinuses, or from direct infection by a penetrating injury. In dogs it may also occur as a progressive spread of an apical infection of a molar tooth, or result as a suppurative local process of one of the infective diseases, namely distemper. It is not uncommon in dogs for the condition to arise without any obvious local or general cause, and in these cases the suppuration usually points below and towards the outer canthus. This may be due to infection of the orbital (salivary) gland. Conjunctivitis in some form is almost always present.

Treatment consists in relieving the distress of the animal by the application of fomentations or some of the forms of kaolin paste, while pus should be at once evacuated when formed. It should not be forgotten that a direct infection of the cavernous venous sinus, with septic meningitis and pyæmia, may result from a spread of pyogenic organisms along the ophthalmic veins.

Tumours.—The primary malignant tumours of the orbit may be sarcoma and endothelioma, but neither is very common. Secondary invasion of the orbital structures may occur due to epithelioma, commencing in many cases in the membrana nictitans.[1] Benign tumours of the orbit may occur occasionally, as fibromata and dermoids.

The treatment in all cases is removal of the growth as early as possible. H. A. W.

HERNIÆ

Abdominal Hernia in the Horse

Abdominal hernia is of two kinds:

(1) External abdominal hernia.
(2) Internal abdominal hernia.

External Abdominal Hernia

Definition.—A hernia is the protrusion of an abdominal organ through an accidental or physiological opening in the abdominal wall to form a swelling beneath the skin, which remains intact.

Parts of a Hernia.—A hernia comprises:

(1) The hernial opening or ring.
(2) The hernial swelling.

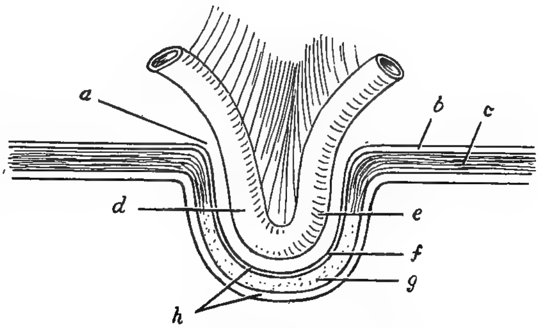

Fig. 186.—Parts of a hernia.

(*a*) edge of hernial opening, (*b*) and (*f*), parietal peritoneum (*c*) muscle; (*d*) hernial contents; (*e*) bowel; (*g*) fibrous tissue between peritoneum and skin; (*h*) hernial sac.

(1) **The Hernial Opening.**—The hernial opening may be an accidental rupture of the abdominal wall (ventral hernia), or a persistent prenatal opening (umbilicus), or a normal passage more or less dilated (inguinal canal).

Its size, as a rule, varies from that which will admit the insertion of one finger to that admitting four fingers of the extended hand, but in exceptional cases it may be much larger.

Its shape may be round, oval, slit-like, or irregular. It may be a simple orifice, or in the form of a passage with an upper and a lower opening as in inguinal hernia.

(2) **The Hernial Swelling.**—The hernial swelling varies in size from a grape to a man's head, or rarely, something much larger. Its shape may be more or less hemispherical, cylindrical, or cone-shaped. It comprises (1) the hernial sac, and (2) the hernial contents.

(1) **The hernial sac** encloses the hernial contents and is composed from without inwards of skin, perhaps a few muscular fibres, fibrous tissue, and parietal peritoneum, but the last-mentioned structure may be absent in ventral hernia owing to its being ruptured by the violence which caused solution of continuity in the abdominal wall. Some authorities confine

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[1] See "Tumours of the Eye," p. 774.

the term "sac" to this peritoneal layer of the hernial coverings, and speak of the others as accessory envelopes. There may be a large amount of thickening in the fibrous portion of the sac, particularly in an old hernia, and in the latter case it may contain calcareous material. This fibrous thickening may give the impression that there is adhesion between the sac and its contents. The sac has a neck and a body, the former being the part next the ring and the latter the remainder of the structure. The serous sac has an exquisitely smooth inner surface which facilitates the escape of abdominal organs from the peritoneal cavity. It is thrown into folds at its neck, and these may in exceptional cases become united by inflammatory adhesions, and tend to or actually close the entrance to the sac by the process of cicatrization.

(2) **The hernial contents** are usually a loop of bowel with its ingesta and attached mesentery (*enterocele*), or omentum (*epiplocele*), or both (*entero-epiplocele*), less frequently the stomach (*gastrocele*) or bladder (*vesicocele*), and rarely some other abdominal organ (spleen, liver). In addition there is often present some serous fluid (hernial fluid). In subjects like the ass and mule, in which there is much sub-peritoneal fat, and in which the hernia is small, the contents may be composed entirely of subserous adipose tissue which prevents protrusion of the peritoneum and abdominal viscera through the hernial orifice.

Varieties of Herniæ.—Herniæ may be classified according to their situation, viz. umbilical hernia (*omphalocele, exomphalos*), inguinal hernia (*bubonocele*), scrotal hernia (*oscheocele*), ventral hernia, femoral hernia, and perineal hernia; or according to the nature of the hernial contents, viz. enterocele, etc.; or according to the condition of the contents as follows:

(*a*) **Reducible hernia,** in which the contents can be readily pushed back into the abdominal cavity through the hernial opening.

(*b*) **Irreducible hernia,** in which they cannot be returned to the peritoneal cavity.

Irreducible hernia comprises (1) Incarcerated, (2) Strangulated, and (3) Adherent hernia.

(1) **Incarcerated hernia,** where the contents are too large to pass through the hernial ring into the abdomen.

(2) **Strangulated hernia,** where the contents are not only incarcerated but are so compressed by the hernial orifice or by the constricted neck of the sac, or by both, that their circulation is arrested and the lumen of the bowel is obstructed, causing them to undergo death or gangrene within twenty-four hours if relief is not forthcoming, micro-organisms passing from the interior of the viscera through its weakened or mortified walls into the peritoneal cavity, and giving rise to a fatal peritoneal septicæmia. The cause of the strangulation is a sudden increase of the intestinal contents in the hernia, producing obliteration of the lumen of the efferent end of the herniated loop of bowel by pressing its walls together against the edge of the ring. Eventually the mutual pressure of the two parts of the loop effectually closes its entrance and its exit, causing fæcal stasis and arrest of the circulation in the part. The double dovetailing of the mesentery, attached to the affected part of the bowel between the abdomen and the hernia, acts as a wedge in the opening, and shares in the process of strangulation. The intestinal mucous membrane at the constricted part acts like a valve gliding on the other coats of the organ, and tending further to occlude the passage and imprison the contents of the herniated portion of bowel. In the early stages of strangulation there is venous congestion of the contents owing to the blood continuing to flow in through the arteries for some time after the veins have become occluded, the constriction affecting the latter first on account of their thin walls. There may also be small hæmorrhages due to the rupture of congested capillaries. There is a variable quantity of serous fluid in the sac resulting from the venous engorgement.

The bowel may be much altered in colour, appearing blackish from cyanosis and ecchymosis, and yet retain sufficient vitality to regain its normal condition, but on the other hand the alteration may not appear serious, yet when the piece of bowel is returned to the abdomen it undergoes gangrene and causes death from peritonitis. When strangulation has been in existence for some time the signs of death in the strangulated bowel are unmistakable; it becomes blackish, greyish, or yellowish in colour, and may be ulcerated or perforated.

In entero-epiplocele the omentum, swollen and hyperæmic, supports part of the pressure, relieving to some extent the bowel, in which the lesion is less marked and slower in forming than in a case of enterocele. When the strangulation is not very acute, adhesions form between the contents and the sac, especially at its neck, and may be sufficient, in exceptional cases, to shut off the peritoneal cavity while perforation of the sac takes place externally. There may be only a portion of a loop of intestine strangulated, one wall only of the bowel being caught or pinched in the hernial ring.

(3) **Adherent hernia,** in which the contents are united by inflammatory adhesions to the lining of the sac. When recent, the adhesions are fibrinous and easily ruptured, but when of long standing they are fibrous and permanent. They may be in the form of bands or plaques. They prevent complete reduction of the hernia,

and may constrict the bowel, giving rise to strangulation.

Etiology.—Hernia may be congenital, as is often the case with umbilical and inguinal herniæ. The etiology of acquired hernia comprises (1) Predisposing causes, and (2) Exciting causes.

(1) *Predisposing causes* include heredity and conditions which lead to the formation of weak points in the abdominal wall, such as imperfect closure of the umbilicus, deep wounds, contusions, or abscesses, or which bring about increased intra-abdominal pressure, such as straining from diarrhœa or constipation or parturition, fits of coughing, and tympany.

(2) *Exciting Causes.*—The exciting causes comprise increased intra-abdominal pressure, which tends to force the viscera through the weak spots in the wall of the abdomen, and violent impact against a blunt body, which causes rupture of the rigid muscles whilst the skin, by virtue of its mobility and elasticity, suffers merely from contusion.

Symptoms.—The symptoms are (1) Physical, and (2) Functional.

(1) *Physical Symptoms.*—The physical symptoms are due to the presence of the hernial swelling, which varies in shape and size as already described, and presents features which differ according to the nature of the hernia. It is elastic to the feel in the case of enterocele, and doughy in that of epiplocele ; manipulation of the former may produce a gurgling noise and detect the vermicular movement in the bowel. If the herniated portion of intestine is distended with gas it will be tympanitic on percussion, and if it contains a quantity of fluid it will fluctuate on palpation. It may be tympanitic towards the neck of the sac while fluid occupies its lower part. In entero-epiplocele there is a combination of the foregoing characters. In reducible hernia the swelling can be diminished or made to disappear by pushing the contents into the abdomen, when the edges of the ring can be readily felt by inserting two or more fingers through the opening. During manual reduction of the hernia, bowel slips back suddenly into the abdominal cavity, accompanied as a rule by a gurgling sound, while the omentum is more gradual in its disappearance and may transmit a slight sense of crepitation to the hand due to friction against the walls of the sac. When both are present the former is reduced first. If the patient makes a sudden effort or is made to cough, the swelling can be seen and felt increasing in size, a sense of expansion or repulsion being perceived by the hand when applied to the enlargement. When adhesions are present it is possible to diminish the swelling by pushing it through the hernial ring, but the sac cannot be detected from the contents.

Incarcerated hernia gives rise to similar symptoms, except that it cannot be reduced and the ring cannot be easily felt.

Strangulation is usually indicated by well-marked symptoms. The swelling increases in size, becomes hard and tense, painful and irreducible, and fails to expand or convey an impulse to the hand when the patient is compelled to cough. As a rule the hernia has been in existence as an ordinary rupture for some time before becoming strangulated, but sometimes it is strangulated at the time of its production and is then spoken of as **acute hernia.** After gangrene has set in, the inflammatory symptoms disappear and the hernia becomes cold and insensitive.

(2) *Functional Symptoms.*—In an ordinary reducible hernia the functional disturbance is practically nil. There may be some evidence of indigestion, and an occasional slight attack of colic. Incarcerated hernia is more likely to be accompanied by these symptoms. Strangulation is usually associated with severe and continuous abdominal pain, a febrile reaction, and symptoms of obstruction of the bowel. The animal may lie on his back to try and obtain relief from the pain.

When gangrene supervenes the pain subsides, and the patient becomes dull and listless, with a subnormal temperature, an almost imperceptible frequent pulse and cold extremities, being in fact moribund.

Deceptive cases are occasionally met with where the local inflammatory phenomena are not very severe and the symptoms of abdominal pain are not very marked, yet gangrene and death supervene if intervention is too long delayed.

Diagnosis.—The diagnostic features of reducible hernia are its reducibility, the presence of the hernial ring, and the expansion of the swelling against the hand during coughing. Diagnosis is more hesitating with incarcerated hernia, but it is generally arrived at after careful examination. Conditions with which it may be confounded are abscess, tumour, hæmatoma, and aneurism, but any person familiar with these lesions is not likely to confuse them with hernia. In strangulation the characteristic symptoms are the local phenomena and the general disturbance. When doubt exists it may be removed by making an exploratory puncture with a fine trocar and cannula or an exploratory needle, which will help to reveal the nature of the swelling. Rectal examination may also be of assistance.

Prognosis.—Congenital hernia (inguinal, umbilical) may disappear spontaneously within one year after birth, the opening closing as the muscles develop. Its cure is favoured by the bowel becoming distended by hard food and by nutritious diet, and is therefore much more likely to occur in colts when they are housed and hand-fed during the winter. If it does not supervene within this period the hernia is likely to persist and may increase in size. As time goes on the sac may become greatly thickened by an increased amount of fibrous tissue. The contents are always more or less exposed to external injury, especially in a large hernia, on account of the prominence of the swelling and the inadequate protection afforded by the hernial sac. A big hernia may interfere with a horse's usefulness. A horse with a hernia may work all his life without suffering inconvenience, but there is always the danger of strangulation taking place, and from this point of view recent hernia is more serious than old hernia, and irreducible is more dangerous than reducible hernia. When the hernial swelling is large compared with the size of the hernial ring, strangulation is more likely to supervene. It is more apt to occur in horses doing hard work than in those doing light work, and the small intestine is more easily strangulated than colon or omentum. Strangulation of the intestine is obviously a very dangerous condition.

Treatment consists in adopting measures which will have the effect of returning the hernial contents into the abdomen and causing cicatrization in and consequent closure of the neck of the sac, and therefore obliteration of the hernial orifice. Its details will be given in connection with the different forms of hernia.

Umbilical Hernia

Synonyms.—Omphalocele, exomphalos.

Etiology.—Umbilical hernia may be congenital or acquired during the first few weeks after birth as the result of straining from diarrhœa or constipation, or from the exertion of playing or gambolling, or making some effort involving violent contraction of the abdominal muscles.

Viscera appearing in a dilatation of the cord without a covering of skin is a prolapse of the bowel and must be distinguished from hernia.

The hernial contents may be either bowel (cæcum or colon) or omentum, or both.

The hernial sac is composed of skin, fibrous tissue, and parietal peritoneum. The fibrous tissue is in the form of a fibrous membrane which is often very much thickened at the base of the sac.

Symptoms.—The symptoms are those of a hernia at the umbilicus, the swelling and hernial ring varying in size and shape as stated.

Prognosis.—Incarceration or strangulation seldom occurs, probably on account of the nature of the contents. It frequently disappears spontaneously. It may disappear within the first six or twelve months of age as the result of the bowel becoming distended with solid food and the abdominal muscles developing and filling up the opening in the abdomen as the animal grows. Adhesion between the sac and contents is rare.

Treatment.—When the animal is under one year old and the hernia is reducible and not threatened with strangulation, nature may be trusted to effect a cure of her own accord or she may be assisted by the use of a truss, blister, or caustic agents, which are of little or no avail in older animals. A *truss* is a pad which presses against the hernial opening and retains the hernial contents in the abdomen, thereby favouring closure of the entrance to the hernial sac. It is kept in position by a roller. It requires to fit accurately and to be well adjusted, otherwise it may become displaced or cause chafing or even necrosis of the skin. The patient may resent wearing it, and fret and fail to thrive from the irritation caused by it. When of a good pattern and properly applied it is undoubtedly a useful contrivance, although it may often obtain credit for effecting a cure which might have occurred without its aid. A *blister* applied to the hernial sac will cause a certain amount of inflammatory swelling, which will tend to push the contents of the hernia into the abdomen and give rise to subsequent fibrous tissue formation and cicatricial contraction, which will help to reduce the size of the sac and that of the hernial opening. The application of a caustic will cause an eschar and the same results as a blister, but to a more marked degree. Sulphuric acid 1 part to 3 parts of water, applied daily for five to eight days, has often been used with apparently good effect. Pure nitric or sulphuric acid applied in lines with a glass rod not more than twice is also of service. The hair should be clipped before applying these dressings. The action of the caustic must be carefully watched, for if used too often or rubbed in too much a deep slough may form and be followed by prolapse of the bowel. Chromic acid, bichromate of potash, or the actual cautery may also be used.

Bandaging and blistering combined is a method which, though more effective than either alone, is apt to cause chafing and great irritation. These irritant and caustic topics frequently fail to have the desired result and may, when repeatedly employed, cause great thickening of the sac, blemishing of the skin, and inflammatory adhesions between the sac and the contents, thus making operative intervention more difficult and dangerous.

Subcutaneous injection of one to two ounces of a 15 per cent solution of common salt is another form of treatment with results similar to those of the agents just mentioned, but it has been known to cause severe sloughing. The injection of a few drops of a 10 per cent solution of zinc chloride has, according to a French authority, Launelongue, given remarkably good results in the treatment of chronic hernia in man. All the methods of treatment mentioned above are of doubtful benefit. If an almost certain cure is required it is better to proceed as in the treatment of older animals and adopt one of the following methods :

(1) *Ligation of the Hernial Sac.*—Clip the hair from round the neck of the sac before casting the animal. Control him in the dorsal position by means of side lines, or hobbles and a back strap. Chloroform is not necessary but is an advantage in preventing struggling, which interferes with the reduction of the hernia. Prepare the site of the operation by shaving and washing with an antiseptic solution or by the application of tincture of iodine after dry shaving. Reduce the hernia ; then draw up the empty sac as much as possible from the abdomen, transfix its neck cautiously, flush with the abdominal wall, with a couple of skewers or special strong pins or even horse-shoe nails inserted at right angles to each other, and turn down their points with a bone forceps. Apply a strong india-rubber ligature tightly round the neck of the sac between the pins and the abdominal wall. The skewers may be inserted after first putting on the ligature. To facilitate drawing up the sac from the abdomen sterilized pieces of cord may be passed through it, one at its anterior and the other its posterior end, and formed into loops to serve as handles, or a clam may be applied near its base for the same purpose. A stout silk or whip cord or fishing-line ligature may be used instead of rubber, and must be applied very tightly, either end being wound round a short metal or wooden rod to afford a grip for this purpose. It has the disadvantage that after some time, when it has cut partly through the tissues, it loses its compressive effects, so that it may be necessary to apply another ligature to produce the desired effect ; as a rule, however, this is not necessary. If the sac be too big for a single ligature, pass a large needle furnished with the cord through the centre of the neck of the sac and cut it close to the needle, thus making two ligatures. Intercross the latter and ligate the sac in two sections. If necessary, three or more ligatures could be applied in a similar fashion. The important point is to make sure that the hernia is completely reduced before applying the ligature or passing the skewers or needle through the sac. The ligature, especially the elastic one, must not be put on excessively tightly for fear of causing too early sloughing of the sac. If reduction be difficult, taxis on the bowel per rectum may be practised, and if its return is prevented by tympany or distension with fluid it may be tapped or aspirated. If adhesions are present the sac must be opened aseptically and the adhesions separated by the finger if recent, or by careful dissection if old, but in such cases the procedure for the radical operation is advisable.

Ligation can be performed in the standing position, but not so satisfactorily as in the recumbent position. This is a very good method for hernia of moderate size, being almost always successful.

(2) *Use of Clams.*—The procedure here is the same as in the last instance, only a clam is used instead of a ligature. It is applied very tightly to the neck of the sac, as close as possible to the abdominal wall and parallel to its long axis. In the case where the umbilical opening is very close to the sheath the clam may have to be placed crosswise to prevent its interfering with this structure, but this is seldom necessary and should be avoided as much as possible, as the clam is less secure in this position, being more likely to be caught by something or by the patient's foot or teeth and torn off along with the sac, thus leading to eventration of the bowels. Pins or horse-shoe nails may be inserted transversely beneath the clam to prevent its slipping, or it may be secured by a few sutures passed through the sac above and below the clam and tied round the latter, or it may be fixed to a surcingle applied round the body. The clam may be made of wood or aluminium or iron, the first two having the advantage of being light. Unless the wooden clam is stout in its transverse diameter and provided with narrow opposing surfaces or edges it has not the same compressive effects as one made of metal. The edges of the metal clam are serrated to give them a grip on the skin. There are various patterns of clam : a common form is that whose two portions are brought together by a screw at either end ; another one has a screw at one end and a hinge at the other. It cannot be fitted so evenly as the first one. Mr. Allen, of Dublin, has invented a metal clam whose two parts are kept in close opposition by means of a spring. Wooden clams may be fixed by means of cord at either end, or preferably by thumbscrews, which ensure more even and constant pressure. Desmesse and Degive, of Belgium, advise the use of two wooden clams for large herniæ, one applied above the other, the function of the lower one being to prevent the upper one slipping.

In the case of a clam with screws it is advisable to turn the latter occasionally to maintain the pressure of the instrument on the sac as it cuts through the tissues, but care must be taken not to overdo this lest separation should take place too soon before cicatrization or closure of the opening is complete. Aluminium clams are not very reliable, being easily broken.

This is also an excellent method of treatment and is more easily carried out than that of ligation.

After-treatment.—After operation the animal may be put in a loose-box or, if the season permit, on grass. He should be kept under observation lest he try to interfere with the clam. The sac and its vicinity should be dressed with an antiseptic once daily until the sac, along with the ligature or clam, falls off. This precaution is often omitted without the patient suffering any ill-effects. Laxative diet is indicated, and bulky food should be restricted as it distends the abdomen and may overstretch the recent and comparatively weak cicatrix and lead to a recurrence of the condition. For the same reason violent exertion should be prohibited for months afterwards, until the scar tissue becomes strong, more particularly if the hernial ring has been large.

Subsequent Phenomena.—Whether the clam or ligature be employed the subsequent phenomena are the same. The animal may evince slight colic occasionally for a few hours after the operation, but as a rule he seems unconcerned. On the following day inflammatory symptoms appear around the umbilicus, which becomes the seat of a hot œdematous swelling, and the sac becomes cold and purplish. There may be some inappetence and a rise of temperature, but otherwise the patient is normal. Towards the fourth day the sac is dead. On about the twelfth or fifteenth day the ligature or clam and the sac fall, leaving a more or less extensive wound and considerable œdema, which gradually disappears. A depression is observable in the position of the umbilicus, but at the end of three or four weeks the wound is completely healed and the umbilical opening is totally obliterated.

Complications.—These methods have seldom any untoward result, but cases are recorded now and again where the sac and clam came off, or were torn off too soon, and prolapse of the bowel followed. Recurrence of the hernia may take place within one year after operation, but it is very uncommon and rarely supervenes at a later period.

Suture of the Hernial Sac.—Having reduced the hernia, grasp the sac with the fingers and thumb as close to the abdominal wall as possible and, inserting the needle immediately below the thumb, pass a series of interrupted stout Halsted silk sutures across the neck of the sac about half an inch apart. This brings about adhesion by cicatrization between the surfaces in contact and consequent closure of the hernial orifice. The empty sac may afterwards undergo atrophy and become obliterated or persist as a swelling of variable size, which may be excised when the hernial ring is permanently occluded, the resulting wound being sutured. The advantage of this method is that it is not followed by sloughing of the sac and the consequent risk of prolapse of the bowels as in the case of the use of the clam or ligature when separation takes place too soon. An objection to this procedure is that infection may possibly spread along the sutures from the skin into the abdominal cavity and cause peritonitis, but experience has shown that this complication is rare. Should it be necessary to open the sac, or should the hernial orifice be unusually large, proceed in a similar fashion, including the abdominal wall in the sutures, the fingers of the left hand being kept in the abdomen to guide the needle clear of the viscera when inserting the sutures. In this case it is essential to keep an antiseptic compress in contact with the wound for five or six days until union has occurred in the peritoneal part of the wound.

(3) *Radical Operation.*—The radical operation is indicated in those cases where the sac has to be opened to relieve strangulation or to separate adhesions, or where one of the above methods has failed, or when the hernia is abnormally large. Performed with proper aseptic and antiseptic precautions it is without danger. Keep the animal on laxative concentrated diet for a couple of days before operation and have him fasting on the morning of same. During the preparatory stage it is advisable to have the hair clipped from the hernial sac and its immediate vicinity and the region well washed, first with soap and water, and afterwards with ether and an antiseptic lotion. Cast and anæsthetize the patient and fix him in the dorsal position with the hocks well flexed and separated. Apply cloths wrung out of an antiseptic round the feet to prevent dust falling from them into the wound. Shave and wash with ether and antiseptic the site of operation, or apply tincture of iodine to it after dry shaving. Damp the hind limbs and surrounding parts with an antiseptic to prevent dust contaminating the field of operation. Have your hands, instruments, and materials sterilized and, everything being ready, make an incision through the skin and fibrous covering of the sac over its centre or at a point where there is no adhesion parallel to the long axis of the body from the anterior to the posterior extremity of the swelling.

Isolate the delicate peritoneal lining of the sac from its other coats, reduce the hernia, seize this portion of the sac with an artery forceps, twist it into a cord, and apply a silk ligature round its neck as high up as possible, amputate the sac below the ligature, return the stump into the abdomen, freshen the edges of the hernial ring by scraping them with a knife or snipping them with scissors, and then bring them together with strong interrupted silk sutures. Shorten the skin to the required length and then suture it. Dress the external sutures with collodion and iodoform. When the patient rises, cover the wound with an antiseptic pad and bandage, which, however, are not essential. Put the patient in a hygienic loose-box and give him the usual hospital diet. Healing by first intention may ensue but it is not the rule. When the wound suppurates, some or all of the buried sutures will require to be removed. If adhesions are present the peritoneum must be perforated to permit of their separation. If the latter is impossible the peritoneum may be cut round the adherent portion, which is then returned with the bowel.

If it be omentum that is adherent it may be excised after ligation if it is vascular.

If there be strangulation, lay open the peritoneal sac on a director to avoid wounding the viscus. Then introduce the index-finger into the neck of the sac beyond the stricture, pass a blunt-pointed straight knife along the dorsum of the finger flatwise, and, having cleared the stricture, turn the edge towards it and incise it sufficiently to permit of reduction of the contents. If there is not room for the finger in the stricture, insert a hernia-director instead or pass the knife alone cautiously through it on the flat with the edge directed away from the bowel.

During the operation of suturing, keep the fingers of the left hand in the abdomen to guide the needle clear of the abdominal organs. A very curved needle on a handle is the most suitable for suturing the ring.

Should the abdominal opening be large, a pad of lint laid on the abdominal organs beneath the wound will serve as a protection to them, and prevent their escape should the patient make an unexpected and violent struggle.

If the strangulated organs are undergoing necrosis the case may be considered hopeless. The indications here are to resect the necrotic portion of the bowel and unite the two ends by Lembert sutures or by an anastomosing button (Murphy's).

It is not worth while operating if the patient is *in extremis*, in a state of profound toxæmia and exhaustion.

(4) *Degive's Method.*—In 1894 Degive introduced a method of treatment which he said was superior to all other methods.

The procedure is as follows: Take the usual preliminary precautions for an abdominal operation as described above. Open the sac at about its centre to an extent sufficient to admit the first two fingers of the left hand. Pass a stout, slightly-curved needle, with a handle about ten inches long altogether, through the lips of the anterior half of the ring, not more than $\frac{3}{8}$ of an inch from its edges, going through the skin, abdominal wall, and parietal peritoneum, guiding it clear of the abdominal viscera by means of the fingers in the abdomen. Pass another needle of the same kind in the same way through the posterior part of the ring. Apply a clam between the needles and abdominal wall, screwing it as tightly as possible with the fingers and then screwing it a little more with pincers. When the clam has been secured withdraw the needles and insert in their stead pins or skewers as described, horse-shoe nails answering the purpose very well. This procedure has the effect of turning the edges of the hernial ring outwards and bringing the serous surfaces into close contact and maintaining them there until they become united. Owing to the way the clam is applied, a portion of the abdominal wall all round the ring is included in it and sloughs away along with the sac. Its place is taken by scar tissue, an imperfect substitute for the original specialized resistant structures. The fact is that, except for the closure of the hernial opening, the wall of the abdomen is on that account weakened instead of strengthened by this operation. It predisposes to recurrence of a much larger hernia, through rupture of the extensive cicatrix. This unpleasant sequel is not, of course, the rule, but it has occurred sufficiently often, judging from reported cases, to make one hesitate about performing it, although one is tempted to do so—the procedure is so expeditious.

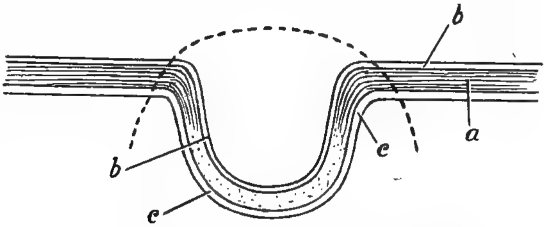

Fig. 187.—Empty hernial sac.

The dotted line shows the course of the needle through (*c*), (*a*), and (*b*), in Degive's method.

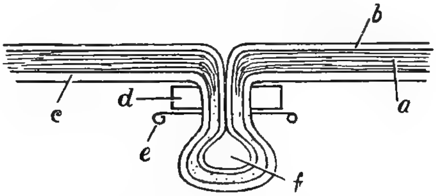

Fig. 188.—Clams, fixed position.

(*a*) muscle of abdominal wall; (*b*) parietal peritoneum; (*c*) skin; (*d*) clams in position; (*e*) pin inserted beneath the clam; (*f*) portion of hernial sac.

The author has had success with it in every case except one, in which the hernia recurred and was four times the size of the original one.

In all the recorded cases of failure the ring of the recurrent condition was much larger than that of the primary one. The recurrence usually appears some months after apparent cure has been accomplished.

Modifications of the Degive Method.—(1) In a case where the sac must be opened, and it is considered undesirable to include the abdominal wall in the clam, the needles may be passed through the neck of the sac, inserting them at some distance from the edges of the ring to ensure the sac being well drawn out from the abdominal wall and the clam being applied as closely as possible to the latter between it and the needles.

(2) Proceed exactly as described in the Degive method until the needles are inserted, and then apply the clam (metal clam) just tight enough to keep the serous surfaces in contact. Insert a series of Halsted or mattress sutures through the ridge of tissues on this side of the clam close to the latter and about half an inch apart. Make the ridge of uniform height by cutting away the higher part of it, skin and fibrous tissue, and unite the cut edges of the skin with ordinary interrupted sutures. Dress the line of sutures with an antiseptic such as tincture of iodine or compound tincture of benzoin. Remove the clam, apply a large, moist, antiseptic compress over the seat of operation secured in position by a bandage round the body. Saturate the compress two or three times daily with a reliable antiseptic solution, such as hypochlorous acid or perchloride of mercury (1 in 1000) to prevent the possibility of infection extending along the sutures to the abdominal cavity.

Advantages of this Method.—(*a*) The lips of the ring are accurately and securely maintained in contact. (*b*) There is no loss of abdominal wall, as sloughing does not occur. (*c*) The abdominal cavity is closed during the process of suturing, which can be rapidly performed with a straight needle. (*d*) There is no danger of prolapse of the bowel during or after the operation.

The author has performed this method with success in a case where the hernial opening was 7 by 6 inches.

(3) Isolate the peritoneal sac as in the radical method, ligature and remove it, and then proceed as in No. 2, inserting the needles through the skin and muscles only, not through the peritoneum.

There will be no danger in this case of infection spreading along the sutures to the peritoneal cavity, as they are outside it. This procedure is the safer operation, but the other one can be more quickly performed and is suitable for a ventral hernia in which the peritoneal sac may be absent. In either case the sutures should not be less than half an inch apart, otherwise the blood supply may prove insufficient and the sutures will then have the effect of ligatures or clams, causing sloughing.

Inguinal and Scrotal Herniæ

Inguinal hernia (*bubonocele*) and scrotal hernia (*oscheocele*) are practically the same thing, the latter being merely an extension of the former from the inguinal canal or region into the scrotum.

Etiology.—It may be congenital or acquired soon after birth from causes mentioned for umbilical hernia. In adult animals it may be caused by the hind legs slipping outwards and backwards, thus dilating the inguinal canal; by heavy testicles, which tend to dilate the internal abdominal ring; and by too vigorous copulation, which has the same effect. The more or less erect position in this latter case also favours the condition. Dragging on the cord during castration, or the use of a heavy clam for this operation, may lead to its formation in the gelding. The sac of the hernia is formed by skin, dartos and tunica vaginalis. The contents may be intestine or omentum, or both.

Prognosis.—When congenital it may disappear spontaneously, as already stated. Occurring suddenly in adult stallions it is usually strangulated. When large it may interfere with usefulness. It is more likely to become strangulated than other forms of hernia.

Symptoms.—The swelling may be invisible—that is, it may not appear outside the external abdominal ring or it may reach to the hocks. In chronic cases in stallions the testicle on the affected side may be atrophied.

The hernial contents are usually to the inside and in front of the spermatic cord or testicle, and are commonly situated at about the level of the epididymis, but in scrotal hernia they may be on the floor of the scrotum.

An incomplete inguinal hernia, not appearing outside the external abdominal ring, is difficult to detect. It may never be suspected until it becomes strangulated, and even then it may not be diagnosed. Rectal examination may reveal the bowel or omentum extending into the inguinal canal.

Recent inguinal hernia generally interferes with the gait, causing the hind limbs to be abducted and the toes to be dragged.

The testicle of the affected side may be drawn up and there may be slight colic. These symptoms may pass off or they may become intensified owing to strangulation taking place. The symptoms of strangulation have already been dealt with.

Diagnosis is made out from the characteristic symptoms of a hernia in the inguinal or scrotal region. Distinguish it from sarcocele (a hard tumour of the testicle) and hydrocele (dropsy of the tunica vaginalis), which always occupies the floor of the scrotum and can be displaced from one part of it to the other. In the gelding, distinguish it from scirrhous cord and cyst of the end of the latter, following castration.

Treatment.—(1) **Reducible Inguinal Hernia.**—In foals and young animals closure of the inner abdominal ring may be attempted by causing inflammation of the spermatic cord and consequent adhesion of it to the tunica vaginalis by vigorous rubbing of the skin at the level of the cord, or by tying a woollen cord above the scrotum and leaving it on for eight hours. Applying an irritant over the cord may have a similar effect.

Cure may occur, however, in these animals without any treatment, and the measures mentioned are not very practicable, neither are they much in vogue. Trusses are difficult to adjust in the inguinal region. In animals one year old and upwards the best treatment is to proceed as in the covered operation for castration, as follows :

Cast and anæsthetize the patient and fix him in the dorsal position. Having taken the usual precautions, cut through the skin and dartos without incising the tunica vaginalis ; enucleate the latter as high up as possible, give the cord one or more complete twists so as to close the sac inside the canal, and apply a clam round the cord outside the tunica vaginalis as close to the external abdominal ring as possible. When the clam is short it is more easily fitted high up, but then it becomes so embedded in the tissues that it is difficult to remove. A comparatively long wooden clam whose ends are outside the scrotal wound proves just as effective as the short metal one and has the advantage of being easily taken off. A ligature may be used instead of a clam, and is preferred by some operators on the ground that it can be applied further up on the cord, thereby more effectively closing the neck of the sac, but it is objectionable because it usually becomes septic, causing suppuration in the upper part of the wound, whence infection may spread to the peritoneum and cause peritonitis. The suppuration will continue until the ligature falls out or is taken away. To facilitate its removal, one end may be left protruding through the wound, but doing this favours sepsis by exposing the thread to contamination. When the patient is a stallion cut off the testicle about half an inch below the clam or ligature. The clam may be left on until it falls or is taken off in six or seven days or longer. If adhesions are present or suspected, the tunica vaginalis must be opened to separate them or to explore the interior of the sac.

(2) **Strangulated Inguinal Hernia.**—It may be possible to reduce the hernia by scrotal taxis, that is, by manipulating the swelling and pressing upon it at the neck of the sac. This taxis may be mediate, that is, performed without opening the sac, or immediate, that is, after opening it. Care must be taken not to use violence in pressing upon the bowel for fear of injuring it, especially as it is weakened from being strangulated. For this operation it is necessary to have the horse on his back, with the hind quarters raised, and under the influence of an anæsthetic. Taxis per rectum alone or associated with the foregoing may effect reduction. A little sterilized oil injected into the sac will act as a lubricant and facilitate the process. If the bowel is distended with gas or liquid, capillary puncture to permit of its escape may enable it to be returned. It is a mistake, however, to lose much time by these methods ; it is better to perform the radical operation at once, for the longer it is postponed and the more the bowel has been bruised the less is the chance of success.

When it is done soon after the occurrence of the hernia, before the patient is exhausted—not later than twelve hours afterwards—it is very likely to be successful.

Radical Operation.—Prepare and take all precautions as usual. Anæsthetize the animal, and fix him on his back with the hind limbs well flexed at the hocks and drawn outwards. Incise the skin and dartos throughout the length of the swelling at its centre from before backwards and separate them from the tunica vaginalis up as far as the external inguinal ring. In some cases the tunica vaginalis is found ruptured. If not, puncture it at its posterior aspect without injuring its contents. Insert a director through this opening, pass it forward and incise the tunica vaginalis on it to the same extent as the skin wound. The hernial contents and testicle will now be exposed and appear more or less altered. If the loop of intestine is distended with gas or liquid its volume can be diminished by capillary puncture. Bathing it with 0·7 per cent warm sterile saline solution will have a good effect. Having decided that the contents are fit to be returned to the abdominal cavity, pass the left index-finger or the hernia director into the outer part of the hernial sac, and, having closed the point of stricture, introduce a blunt-pointed straight bistoury or herniotome flatwise along the dorsum of the finger or on the director, and when it has just reached beyond the stricture turn its edge outwards and forwards so as to avoid the posterior abdominal artery which is situated to the inner side of the internal abdominal ring, and cut the stricture by a very limited incision. To facilitate this part of the procedure let an assistant draw the testicle upwards and backwards, thus bringing the seat of stricture closer to the operator. In most cases it is sufficient to cut the neck of the sac (kelotomy). The incision must be restricted, for if made too large some of the contents may pass through the opening thus made in the sac, causing false reduction. It is usually easy to return the contents after releasing the stricture. If not, reduction may be assisted by taxis per rectum. Apply the force parallel to the direction of the canal. If the bowel is ulcerated or partially necrosed the ulcer or necrosed patch may be depressed by dimpling the bowel wall at its level and shutting it off from the peritoneal cavity by means of a double row of Lembert sutures inserted on either side of it and tied across it, a procedure which is preferable to cutting out the affected part and then suturing, as the viscus is opened in this case and contamination from its lumen is apt to supervene. Burying the affected spot by suturing (enterorraphy) is only contra-indicated when the lumen of the bowel is narrow, as it may then cause stenosis.

The omentum, whether gangrenous or not, may be amputated, after ligaturing it in a healthy part, if necessary. Apply a clam round the cord outside the tunica vaginalis as before and remove the testicle.

To Preserve the Testicle. Open into the tunica vaginalis outside close to the external inguinal ring, pass the finger or director into the constricted part of the neck of the sac and cut it. Then reduce the hernia and suture the internal wound, or a piece may be removed from the tunica vaginalis at the seat of operation, and the resulting wound therein sutured so as to diminish the lumen of the entrance to the sac and perhaps prevent recurrence of the hernia. The latter may, however, appear again owing to the passage not being definitely closed.

After-treatment.—As usual, place the animal in a hygienic loose box and give hospital diet. Apply an antiseptic solution to the wound once or twice daily.

Complications.—The chief complication to be feared is peritonitis as the result of contamination during the operation, or of bacteria passing through the damaged or necrotic walls of the herniated loop of intestine. Gangrene of the bowel may occur subsequent to the operation. The dry form may supervene and not cause symptoms of peritonitis until eight to ten days afterwards, when separation has taken place and infection has consequently reached the peritoneum from the lumen of the organ. Death may result from septicæmia, shock, or exhaustion.

False Inguinal Hernia.—Here the hernial contents are in the inguinal canal or scrotum, but outside the tunica vaginalis. The hernial ring is in front of the internal inguinal ring. The sac may or may not be lined by peritoneum. The swelling appears higher up and closer to the abdominal wall than true inguinal hernia, and it has been described by Möller as having the appearance of a peaked nightcap.

Treatment.—If not strangulated it is not usual to interfere. If it is necessary to treat the condition, open the sac, reduce the contents, enlarging the ring if required by cutting outwards, and suture the muscle and skin separately. The peritoneum is often ruptured.

Crural Hernia.—A hernia through the crural arch. It is very rare in veterinary practice. It causes a swelling on the inner aspect of the thigh between the sartorius and gracilis where the saphena vein passes between these muscles, and may lead to a straddling gait. If treatment is required, proceed in the usual way and suture Poupart's ligament to the sartorius muscle. In case of strangulation be careful with the knife of the femoral artery.

Perineal Hernia.—Most common in dogs, and will be dealt with in considering hernia in these animals.

Ventral Hernia.—Ventral hernia is a hernia through any part of the abdominal wall other than the umbilical and inguinal regions. It is usually caused by external violence, such as the impact of blunt bodies, but may result from muscular effort, *e.g.* during parturition, when it is also favoured by the distension of the abdomen.

The contents may be intestine, omentum, or both. When recent, it shows the symptoms of a contusion in addition to those of a hernia. Its most common situation is close to the last rib on the left side. Its size varies from that of a man's fist to a man's head, or, rarely, something larger.

Treatment is the same as for umbilical hernia, but it is not so likely to be successful here if the hernia is situated close to the ribs, where the respiratory movements render closure of the ring very difficult. One situated in the flank is in a better position for treatment than one on the abdominal floor, because the weight of the viscera in the latter case is an obstacle to union of the edges of the ring.

Ventral hernia of the size of a man's fist is often present in working horses without causing any inconvenience. In such cases operative treatment is not indicated. Sometimes the hernial ring is so large, or its lips so far apart, that operation is out of the question.

Hernia in the Ox

What has been said about hernia in the horse applies in practically every detail to the same condition in the ox, in which, however, it is less common, and the veterinary surgeon may not be called to treat it except when strangulation is present or there is digestive disturbance preventing the beast thriving.

Occasionally in calves umbilical hernia is met with, in which the contents are adherent to the sac and the patients suffer from chronic diarrhœa, which terminates fatally after weeks or months. Inguinal hernia is not common in the ox, and is more frequently seen in the ram.

Ventral hernia is more frequent on the right than on the left side, although hernia of the rumen may occur in the latter situation.

The fourth stomach may be herniated in the lower part of the right flank between the hypochondrium and the white line.

Hernia in the Dog and Cat

Hernia as it occurs in the dog and cat is similar to that in the larger animals except that it is, of course, on a smaller scale in accordance with the difference in size of the subjects. Vomition is an important symptom of strangulation in the carnivora.

Umbilical hernia presents in the main the characteristics as described in the horse. The size of the swelling generally varies from that of a hazel-nut to that of a walnut. The contents are small intestine or omentum, or both. It is usually congenital and generally diminishes with age, to disappear soon after weaning.

Treatment comprises the following methods: (1) Subcutaneous injection of chloride of zinc 10 per cent aqueous solution. Seldom adopted.

(2) Use of a bandage compressing a pad applied over the orifice after reducing the hernia; but this is seldom satisfactory, as it is difficult to maintain in position.

(3) Radical operation is necessary in chronic or large hernia and in cases of incarceration and strangulation. The principles of procedure are the same as in the horse, but are executed with greater facility and more prospect of success in the small animals. Sometimes a case is met with in which the umbilical opening has closed, incarcerating a piece of omentum in the sac, where it undergoes degeneration.

Inguinal hernia is rare in the dog but common in the bitch. Its symptoms in the former are those of a hernia in the scrotal region. It has little tendency to disappear spontaneously.

To treat the condition satisfactorily it is necessary to castrate the animal by the covered method, applying an aseptic silk ligature over the tunica vaginalis and the cord as high up as possible after reducing the hernia.

In the bitch the hernia usually forms a more or less voluminous swelling in the inguinal region, varying in size approximately from a hen's egg to a child's head, and is fairly often double. It is generally reducible when the patient is placed in the dorsal position. Pregnancy favours its occurrence, but it may occur apart from it.

The contents are, as a rule, one or both horns of the uterus with its broad ligament, which gives a sort of corrugated feel to the swelling when manipulated. Sometimes they are formed by intestine or the bladder. The uterus may be pregnant and is then more likely to become strangulated. Otherwise strangulation is rare. Even in reducible cases the patient sometimes evinces a little pain or signs of discomfort, especially when the hernia is large. The vagina is dragged forwards by the presence of the uterus in the sac and consequently feels somewhat tense and stretched on digital examination.

The condition may be confounded with a mammary tumour, a cyst, a hæmatoma, or an abscess, but reducibility when possible is diagnostic, as is also recognition of the edges of the hernial orifice. When in doubt an exploratory puncture will probably decide the matter.

Prognosis.—There is no tendency to spontaneous cure. It is more likely to increase in size. It may exist for years without endangering the life of the patient, and when the uterus is pregnant delivery of the fœtuses may occur without difficulty, or those in the herniated part may be too large to pass through the hernial ring, necessitating operative interference to remove them.

Treatment.—The only successful treatment is the radical operation, which is similar to that for umbilical hernia.

Procedure.—Having taken all the usual precautions for an abdominal operation, anæsthetize the patient and fix her in the dorsal position. Make an antero-posterior incision two to three inches long over the centre of the swelling, going through the skin and mammary gland but not through the peritoneal lining of the sac. Enucleate the peritoneal sac as far as the hernial ring, taking care to keep close to the membrane to avoid extensive and unnecessary laceration of areolar tissue and the production of a large wound. Reduce the contents, seize the peritoneal sac with an artery forceps and twist it into a cord. Ligature the latter close to the abdominal wall, and amputate it this side of the ligature. If the ring is large insert two or three sutures through its lips. Suture the skin and seal the wound with collodion and orthoform. If the wound beneath the skin is not extensive, healing by first intention may ensue, but as a rule it takes place by second intention, the ligature and deep sutures, when present, becoming contaminated and causing suppuration, which continues until they fall or are taken away in the course of about a week.

This operation is usually a complete success, but care must be taken with delicate and toy dogs to see that they are carefully nursed and made comfortable afterwards, otherwise they may succumb to shock.

Should there be any doubt about complete reduction of the hernia the sac may be opened to make sure, and in case of adhesions, incarceration, or strangulation, opening it will be necessary in order to deal with the existing complication. The simplest procedure in the case of incarcerated or strangulated uterus is to perform partial or complete hysterectomy of the empty or gravid organ, provided that the animal is not required for breeding. In the latter case, if the period for parturition has arrived, hysterotomy is indicated to remove the pups. If the ring is too small to permit of reduction of the empty uterus or other organ, incise it carefully in a forward and outward direction to enlarge it to the required extent, using a director to protect the contents from the knife. After these operations for hernia the animals must be kept quiet for some weeks, prevented from jumping from chairs, etc., for fear of rupture of the cicatrix.

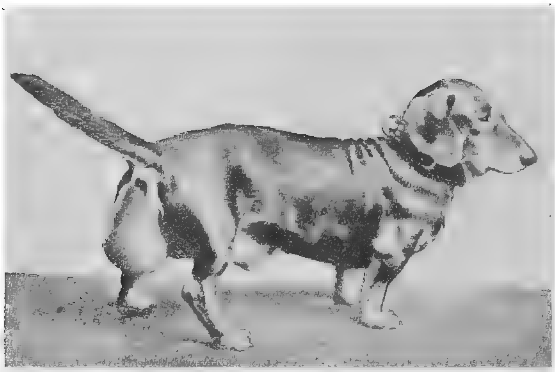
Fig. 189.—An aged dachshund with perineal hernia (omentum). (Hobday.)

Perineal hernia is fairly common in old dogs, usually as the result of straining from constipation or enlarged prostate gland. It is characterized by the symptoms of a hernia at the side of the anus between the base of the tail and the tuber ischii. The anus is deviated laterally by the pressure of the swelling or hernia, which is usually reducible.

The sac is formed by skin, subcutaneous tissue, and peritoneum. The latter is a protrusion backwards of the recto-vesical or recto-vaginal peritoneal cul-de-sac. Raising the fore quarters increases and raising the hind quarters diminishes the swelling. The bladder usually constitutes the contents, and being more or less bent on itself there may be stoppage of micturition, causing colic-like pains, vain efforts to pass urine, and increased tension and pain in the hernial swelling.

Treatment.—Cut through the skin vertically over the centre of the swelling, after taking the usual precautions, and enucleate the peritoneal sac. Ligature the latter and amputate it, shorten the skin, if necessary, and suture it. Should it be impossible to separate the peritoneum for the purpose of ligation, simply remove a portion of the skin and then suture its edges.

It will be necessary to remove the cause of the condition if possible, *e.g.* treat constipation or enlarged prostate.

Internal Abdominal Hernia.—An internal abdominal hernia is the passage of an abdominal organ through an orifice in a membrane or partition inside the body.

The chief forms of internal abdominal hernia are (1) Diaphragmatic hernia, (2) Pelvic hernia.

(1) **Diaphragmatic hernia** is the passage of an abdominal organ, or organs, through an opening in the diaphragm into the chest cavity. The opening is usually the result of an accidental rupture of the tendinous or muscular portion of the structure, such as may ensue on a severe contusion of the thorax—for example, a horse falling in harness and striking the ground violently, or throwing himself recklessly thereon during an attack of colic ; or the accident may be due to a fragment of a broken rib puncturing the diaphragm. Rarely the hernia occurs through the foramen sinistrum, the orifice giving passage to the œsophagus from the thorax to the abdomen. In the latter case the condition may be congenital. Violent contraction of the abdominal muscles, or anything causing great pressure of the abdominal organs against the diaphragm, may be an exciting cause of the lesion. The size of the rupture varies in different cases. It may only admit the passage of a portion of omentum or a knuckle of small intestine, or many of the abdominal organs may pass through it, viz. bowel, omentum, liver, stomach, or spleen.

Symptoms.—The symptoms are not very characteristic. They comprise more or less severe dyspnœa from pressure on the lungs and tympany on percussion and intestinal sounds on auscultation of the thorax.

When the protrusion into the chest cavity is slight there may be little or no interference with health. Raising the fore quarters may relieve, and raising the hind quarters may increase, the dyspnœa and distress of the patient, thus accounting for the latter sometimes sitting up like a dog when suffering from this affection.

When incarceration or strangulation supervenes the usual symptoms of abdominal pain are observed.

Diagnosis is difficult. The history of the case may lead one to suspect it, but in many cases it is only discovered on post-mortem examination. Exploratory puncture may help in this respect. Post-mortem rupture of the diaphragm often occurs from distension of the bowels with gas and consequent pressure on the part, the rent being usually in the muscular portion, whereas ante-mortem rupture more commonly occurs in the tendinous portion.

Prognosis.—When the hernia is large enough to cause functional disturbance the condition is generally serious. When a considerable weight of abdominal viscera passes into the thorax the lungs collapse at once, causing instant death. If it is only a piece of omentum that passes through a small opening and becomes adherent thereto it is of no consequence and is never diagnosed during life. Bowel may become strangulated in the orifice with fatal consequences apart from pressure on the lungs.

Treatment is of no avail. The only rational procedure is to perform laparotomy and reduce the hernia; but a slight case is never diagnosed with sufficient certainty to justify this being done, and in a bad case it would be a foolish undertaking.

Pelvic Hernia in the Ox

Synonyms.—Intra-abdominal, peritoneal hernia, gut-tie, etc. Pelvic hernia is formed by the passage of a loop of bowel through a rupture in the fold of serous membrane which suspends the spermatic cord in the sublumbar and superolateral pelvic regions; or by the compression of a piece of bowel by the spermatic cord which has returned to the abdominal cavity after castration, and become adherent to the abdominal floor in the vicinity of the internal inguinal ring with a portion of the viscera caught between it and the abdominal wall. Castration with violent traction of the cord causes the rupture in its membrane or severs the cord high up, allowing the end to recede into the abdomen and behave as described. The condition occurs on the right side, the presence of the rumen on the left side preventing its occurrence there.

It prevails in mountainous districts, the ascent of heights throwing the abdominal contents backwards and favouring the lesion. Abnormal distension of the rumen also predisposes by increasing the intra-abdominal pressure on the right side. It is well known in some parts of England, is common in Germany, and is rare in France and Italy.

Symptoms.—When not strangulated it causes no symptoms, but when strangulation takes place it is manifested by abdominal pain and by signs of intestinal obstruction, the animal becoming uneasy, lying down and getting up, looking round at the side and making vain efforts at defæcation, passing only particles of fæces or simply mucus. Enemata are expelled immediately. It is diagnosed on rectal examination, which reveals the presence of a soft, doughy sort of swelling at the entrance to the pelvis on the right side near the sacrum, slightly painful on pressure, and of variable size, and due to the strangulated loop of bowel. The tense, stretched spermatic cord may also be felt.

Prognosis.—If relief is not forthcoming the strangulated portion of bowel will become gangrenous, and death will ensue on the fourth or fifth day, or, rarely, it may be delayed until the second week after the accident.

Treatment.—Treatment comprises: (1) Jumping the animal from a height or making it descend rapidly a steep incline. (2) Applying taxis per rectum to draw the herniated portion of bowel out of the orifice. (3) Performing laparotomy to rupture or cut the spermatic cord and release the incarcerated bowel.

The first method of treatment is worth trying in a recent case, as it may succeed when the constriction is slight and no adhesions are present. It offers no safeguard against recurrence of the condition. Taxis per rectum may be successful if the hernia is small and not tightly wedged in the opening. The animal should be controlled, standing with the fore quarters on a lower level than the hind ones to facilitate escape of the bowel from the stricture. The third procedure is the surest and should be done at once in cases of some standing, before the animal is exhausted or gangrene has set in.

It consists in performing laparotomy in the right flank, and introducing the hand into the abdomen to rupture the cord with the finger, or to cut it by means of a hooked knife with a blunt point and a sharp edge on its concavity introduced into the hernial opening, the wound in the abdominal wall being afterwards closed in the usual way. When the operation is done fairly early, before serious alteration has occurred in the bowel, it is usually successful.

J. J. O'C.

SURGICAL AFFECTIONS OF THE HEAD

Contusions of the Cranium.—Contusions of the cranium are not common in veterinary practice on account of the small area of the cranial surface exposed to injury and its being protected by the frontal sinus in the horse and still more so in the ox. In the dog the massive temporal muscles serve to guard the bones against traumatic lesions. A contusion or bruise is caused by violent contact with a blunt resistant object.

Symptoms.—The symptoms are those common to a bruise in any part of the body, the lesion produced being an extravasation of blood or a hæmatoma due to rupture of blood-vessels, and varying in dimensions in different cases. It may be subcutaneous, subaponeurotic, or subperiosteal. If the contusion be very severe the bone itself may be damaged, with ecchymosis into its substance, and even some of the meningeal vessels may be ruptured. Should infection gain entrance to the injured part an abscess may form in the integuments of the bone, and if sepsis extend deeply through the latter it may give rise to an abscess on the dura mater and cause meningo-encephalitis. The presence of infection is indicated by local symptoms of an abscess and by febrile disturbance, and lesions of the brain are revealed by cerebral excitement or stupor or vertigo.

Diagnosis.—Diagnosis of the contusion is easy, but it may be difficult to ascertain the depth of the injury.

Prognosis.—Prognosis should be guarded in the early stages of the affection, as it is impossible then to say whether brain complications from compression of extravasated blood or infection may later supervene. Apart from injury to the brain or extensive necrosis of the bone, recovery is uneventful. When the bone is diseased a sinus persists until the sequestrum becomes separated and is removed. If the brain be involved the condition is serious, and should infection of it occur the case is hopeless. Symptoms due to compression may disappear owing to the effusion becoming absorbed when it is slight, but if it be copious fatal coma is apt to ensue.

Treatment.—The treatment is that for contusion in general (*vide* Contusions). It comprises the use of cold antiseptic applications to arrest extravasation and prevent infection through excoriation of the skin. If the hæmatoma persist beyond a reasonable time it should be opened, evacuated, and swabbed with tincture of iodine to bring about granulation and cicatrization of the cavity. If an abscess or sinus supervene treat accordingly, and if brain symptoms arise treat them according to their nature. Trephining may be done as a last resort to relieve compression by providing an exit for effusion or inflammatory exudate. It generally proves futile. Laxative and absorbent medicine is indicated internally.

Open Wounds.—Open wounds of the cranium are only of special interest when complicated with fracture and injury to the brain or its meninges. They must be dealt with on general principles with the object of preventing sepsis and promoting rapid healing. Even very extensive wounds with considerable bruising or partial fracture of the bone heal quickly in this region when carefully dressed and sutured.

An antiseptic pad, kept in position by a wide bandage or a cap made to fit the head, is advisable to protect the wound, especially in the dog, which has a tendency to scratch it with its paw.

Symptoms of concussion of the brain may supervene when the violence causing the wound has been severe, although the brain may not be penetrated. If the brain be wounded the case is usually fatal, but in exceptional instances complete recovery follows when infection is excluded, or recovery may be incomplete, the patient remaining more or less paralysed or stupefied. Potassium iodide should be prescribed in these cases with a view to causing absorption of effusion which may be pressing on the brain.

If a sinus result from the bone becoming affected with necrosis or caries deal with it as such, curetting the carious surface or removing the loose piece of bone and treating antiseptically.

Fractures.—Fractures of the cranium are fairly common as the result of direct or indirect violence, more frequently the latter, which is usually due to the horse rearing and falling back on his poll, the fracture occurring in the basi-occipital or in the body of the sphenoid. This region of the cranium is easily fractured on account of its being weakened by the numerous foramina it contains.

Symptoms.—The first symptoms to attract attention, as a rule, are those of concussion of the brain, the animal being in a state of collapse, which may terminate in death, or gradually disappear, the patient eventually recovering consciousness and rising in an almost normal condition, or in a state of vertigo or semi-stupefaction.

When the lesion is on the anterior or lateral aspect of the cranium, the deformity caused by swelling or by depression of a fragment of bone, and the presence, perhaps, of an open wound, assist in diagnosis. The latter cannot be positive unless there is noticeable displacement of a portion of the bone or the fracture can be actually seen through the wound. The inner table of the bone may be fractured while the outer one remains intact, the explanation being that the former is the segment of a smaller arc than the latter and therefore cannot withstand the same amount of pressure without breaking.

Fracture of the base can only be inferred from the symptoms, bleeding from the nose and ears being practically diagnostic when it occurs after violence inflicted on the poll.

Prognosis.—The prognosis of fractures of the cranium is always grave. In many cases the patient succumbs immediately from injury to the brain. Exceptionally, the animal gradually recovers from the concussion, but, as a rule, the recovery is imperfect, paralysis or loss of function in some part of the body persisting, or inflammation of the brain or meninges supervening in a few days.

Treatment.—For fracture of the base of the cranium nothing can be done to prevent a fatal result.

In fracture of the vault the treatment is local and general.

Local treatment comprises :

(1) The use of cold antiphlogistic applications to overcome local inflammation, arrest bleeding, and help to ward off meningitis and encephalitis.

(2) Trephining the cranium in the vicinity of the fracture to enable a lever to be inserted to raise a depressed fragment when symptoms of compression supervene.

When the fracture is compressed the leverage may be done through the wound. In simple fracture operative interference should be avoided unless grave trouble is caused by the compression of the bone. A certain amount of pressure can be tolerated by the brain. The operation of trephining the cranium is done in the same way as that for opening the facial sinuses, but care must be taken not to injure the dura mater or the brain with the trephine. To avoid this the point of the instrument should be withdrawn within the crown, when the groove in the bone is sufficiently deep to prevent the trephine slipping, and before the bone is perforated.

As the dura mater is being approached the instrument must be manipulated very cautiously to prevent injury to this structure. To raise the depressed fragments introduce a kind of spatula between the bone and the dura mater. Should the latter be distended with extravasation, incise it to allow the liquid to escape; hæmorrhage is usually slight. If the venous sinus be opened the bleeding can be arrested by the application of a pad and bandage. The operation wound should be sutured and sealed with collodion and iodoform, or a similar topic, and protected by a dressing of cotton-wool covered with a bandage.

Great care must be exercised to prevent infection and consequent septic and fatal meningo-encephalitis.

Hernia of the brain-tissue may occur through the trephine opening. It cannot be reduced, and it is better to leave it alone, when it will slough away, than to remove it by the knife or ligature. It should be covered with moist antiseptic compresses until separation occurs. Recovery may supervene.

General treatment consists in :

(1) Isolating the patient and keeping him in a quiet place.

(2) Bleeding from the jugular vein, when the patient is robust and the pulse is strong.

(3) The administration of a purgative to act as an eliminative and febrifuge and to diminish the risk of inflammation of the meninges and brain.

(4) Adopting appropriate measures for brain affections when they arise, cerebral excitement requiring the exhibition of nerve sedatives and coma indicating the application of the usual methods of resuscitation.

The most dangerous fractures of the vault are those of the parietal, temporal, and upper part of the frontal bones.

Fracture of the occipital crest is not serious, as it is rarely associated with cerebral disturbance.

Tumours.—The cranial region is not a common site of tumours, but some of the ordinary neoplasms may develop on the skin, or subcutaneous tissues at its level, such as papillomata, fibromata, sarcomata, melanomata, or cysts.

Exostoses on the bones projecting into the cavity of the cranium rarely occur and are probably most frequently found in the ox. As a rule they cause no trouble and are only discovered after death.

Treatment.—The only treatment for tumours on the surface of the cranium is excision. Those involving the bones are inoperable, and malignant tumours are generally incurable, as they usually recur after removal.

Cysts require to be extirpated by dissection from the surrounding tissues.

Tumours of the Brain.—Tumours of the brain are comparatively rare, and are most common in the horse, where they usually affect the choroid plexus. They may exist for a long time without betraying their presence, but usually when they attain considerable size they interfere with the function of the brain and give rise to symptoms which are evidently of cerebral origin, including those of nervous excitement, stupor, and paralysis of different parts of the body, depending upon the situation of the tumour. Inco-ordination of movement indicates the cerebellum as the site of the new growth.

Treatment.—Treatment is out of the question. Diagnosis from other brain affections not being easy, it is usual to adopt expectant treatment for a while in the hope that the disturbance may be temporary, and when improvement does not occur in a reasonable time to have the animal destroyed.

Dentigerous Cyst.—A dentigerous cyst is one containing a tooth growing from the bone where it is situated. It is a fairly common condition in the horse, and has been seen, though rarely, in the ox, sheep, and dog. It develops soon after birth, simultaneously with the eruption of the normal teeth. It is generally noticed within the first two years of age.

Symptoms.—At first a soft, painless, more or less hemispherical swelling is detected in the temporal region, a little in front of the base of the ear, occupying a variable position between the middle line of the head and the zygomatic process of the squamous temporal bone. After a while the wall of the cyst ulcerates and it bursts, discharging a glairy fluid, a fistula being then formed whose orifice varies in its situation. In exceptional cases it is not directly over the swelling, but is found in the face border of the concha of the ear near its base or, more rarely, on its inner aspect. A probe passed into the fistula comes in contact with the tooth. The latter is not very firmly fixed, as a rule, but occasionally it is rigidly embedded in the bone, and more rarely causes a protrusion into the cranial cavity. Sometimes several teeth develop successively, a new tooth replacing its predecessor repeatedly after removal of the latter. There may be more than one tooth in the cyst.

Treatment.—Treatment consists in incising the cyst, exposing and removing the tooth, and dissecting out or destroying the lining of the cavity. Cast and anæsthetize the horse, prepare the site of operation as usual, open up the fistula to its depth, arrest the bleeding, and, having thoroughly exposed the tooth, endeavour to seize and extract it with the forceps. If it be too small to be grasped by the forceps or too firmly fixed to be detached this way, loosen it by means of a chisel or punch and a mallet, using them cautiously for fear of fracturing the cranium, or a groove may be made round the base of the tooth by the aid of a sharp chisel handled with great care, to enable the tooth to be grasped with the forceps and to diminish its hold on the bone. The objection to wounding the bone is that infection may supervene and cause necrosis, and that the brain may become involved in the infective process. Moreover, there is a great risk of injuring the brain by interfering with the bone in this way, as it is very likely to fracture, when splinters will probably penetrate the organ, with fatal consequences. When the tooth is rigidly fixed and cannot be got away by using moderate force, it is better to abandon the case. The presence of the cyst will not interfere with the horse's usefulness.

After extracting the tooth, dissect out the lining of the cyst so as to leave a wounded surface, which will granulate and cause obliteration of the cavity by cicatrization. Swabbing with tincture of iodine may have the same effect.

In other animals the procedure is similar and the operation is usually successful. Occasionally the tooth develops outside the cyst cavity.

Dermoid Cysts.—A dermoid cyst may also be found in the temporal region of the horse and other animals, but is much less common in the horse than dentigerous cyst in this region.

The symptoms are similar to those of dentigerous cyst except that a tooth is not present. The treatment consists in dissecting out the lining of the cavity so as to leave an open wound, which will heal in the ordinary way.

Cœnurus Cerebralis (Sturdy, Gid).—The *Cœnurus cerebralis*, the cystic or hydatid form of the *Tænia cœnurus* of the dog, is frequently present on the brain of the sheep, less frequently on that of the ox and goat, and rarely on that of the horse.

This form of the parasite gains entrance to its host by the latter eating grass or food contaminated with the fæces of the dog containing segments of the *Tænia cœnurus*. The disease is perpetuated by dogs consuming the brains of sheep or cattle infested with the cystic form of the worm.

It is usually yearling or two-year-old sheep and young cattle that are affected.

Symptoms.—The symptoms are local and general.

Local symptoms may be absent or quite distinct. In the latter case a swelling can be detected due to the cyst causing pressure, atrophy, and bulging of the bone at its level. The bony tissue may have disappeared when fluctuation can be felt.

General symptoms comprise those of disturbance of the function of the brain, manifested by abnormal movements of the patient varying according to the situation of the cyst as follows: (1) When the crown of the head is held to one side with the corresponding ear at a lower level than the other one, and the animal keeps turning in a circle towards this side, it is a sign that the vesicle is situated on the surface of the cerebral hemisphere, which corresponds to the centre of the circle described. (2) When the sheep trots with the head high the cyst occupies the anterior part of the brain, the olfactory lobe, or the corpus striatum. (3) If localized in the cerebellum or posterior part of the cerebrum the animal has a staggering gait and frequently falls. (4) If developed on the pons Varolii the subject rolls round the long axis of its body. (5) If the eyes roll and lose the power of sight the optic tract is affected.

These movements, however, are not sufficiently regular to be of much practical assistance in determining the exact site of the hydatid. Moreover, there may be more than one cyst on the brain affecting different parts of the organ.

Prevention.—Prevention comprises measures having for their object the removal of the source of the trouble, by keeping sheep-dogs free from tapeworms by the administration of worm medicine, by not allowing, as far as possible, affected dogs on pastures, and by preventing dogs eating brains containing the cysts.

Treatment.—Continuous cold irrigation of the cranium has had a good effect in some cases, causing great improvement in the condition or even complete cure in the course of twenty to thirty days. The surest treatment is the surgical removal of the cyst, which is only possible when it is superficially situated. The operation may be done by means of the trephine or a special trocar and cannula.

(1) *Trephine Method.*—Site. The site of operation is where the local symptoms are discovered. In their absence operate about $\frac{3}{8}$ of an inch behind the inner border of the base of the horn or horn-core, keeping to one side of the middle line to avoid wounding the venous sinus.

Preparation.—Prepare the site with the usual antiseptic precautions.

Procedure.—Excise a circular-shaped piece of skin corresponding in diameter to that of the trephine. By means of the latter remove a disc of bone without injuring the dura mater. When the cyst comes into view remove it intact with forceps, or first puncture it and withdraw the fluid slowly in order to prevent the risk of apoplexy, which might result from the sudden removal of the pressure on the brain. Suture the wound, and seal it with collodion and iodoform, or leave it open and merely cover it with a dressing of tar which is antiseptic and protective from flies.

(2) *Trocar and Cannula.*—A special instrument, whose length does not much exceed the depth of the tissues to be penetrated and about $\frac{3}{8}$ of an inch in diameter, is used.

Having exposed the bone, place the trocar and cannula in position, directed slightly backwards, and drive it through the cranium by tapping it with a mallet. Draw out the trocar, and if the cyst has been penetrated its liquid will escape through the cannula. Empty it completely by means of a syringe or small pump. Try also to withdraw the cyst-wall after removing the cannula, and take it completely away with the forceps.

Some operators use a borer, with a trifacial point and a movable guard on the stem, to puncture the cranium, and then insert the trocar and cannula, leaving the cannula in position and applying the syringe or pump to remove the fluid from the cyst. After the cyst has been emptied the pump may be used to draw the cyst-wall into the cannula, when it is seized with forceps and removed along with the cannula.

Results.—The results of the operation are very variable. When the cyst is superficially situated and removed with little or no interference with the brain, recovery is the rule; when it is deeply situated, searching for it usually causes death.

The complications to which the patient succumbs are hæmorrhage and meningo-encephalitis.

In the ox and in rams, in which the frontal sinus is very extensive, it is necessary to go through it to reach the cranium. Sometimes the bulging caused by the cyst brings the two opposite walls of the sinus into contact so that its cavity at this point is obliterated.

Separation of the Horn. *Etiology.*—The horn is sometimes torn away from the core as the result of direct violence, as often occurs when cattle are fighting in an enclosed place or pen, the beast striking its horn against that of its antagonist or against a wall or paling. It may also be caused in working oxen by the constant irritation of the yoke producing a chronic inflammation of the keratogenous membrane and consequent loosening of the horn, which eventually becomes detached by the animal knocking it against a fixed object. Striking the horns with a heavy stick may also cause luxation of the sheath.

Prognosis.—Apart from the hæmorrhage the accident is of no consequence except in working cattle, in which the yoke cannot be used until the new horn is formed.

Treatment.—Clean and disinfect the exposed horn-core, and protect it with an antiseptic dressing consisting of tow or cotton-wool saturated with an antiseptic lotion (creolin 2 per cent or carbolic acid 2 per cent), kept in position by a bandage attached to the other horn.

Archangel tar smeared over the wounded surface and on the bandage after its application is a very suitable dressing, especially in the summer, when flies are troublesome. New horn is soon formed, but is never of as good quality or appearance as the original horn.

Fissures of the Horn.—A fissure or crack of the horn is due to direct violence, such as a blow inflicted on the horn.

Symptoms.—The fissure may be confined to the horn-core or to its covering, or affect both. In either of the latter cases the fissure is visible and blood is usually observed oozing from it. The bleeding, however, may be delayed for some hours after the accident. When the core only is fissured diagnosis of the condition is difficult, the only indication of the injury being some abnormal heat and hypersensitiveness of the horn in the region affected.

Prognosis.—When the horny tissue only is fissured there is no fear of any complication, but when the core is involved bleeding may take place into the frontal sinus, where the blood will accumulate and lead to the formation of pus.

Treatment.—Apply cold and astringent antiseptic lotions to arrest the hæmorrhage and prevent infection of the wound. A solution of tannic acid 2 to 5 per cent, or gelatine 5 per cent, or Goulard's extract diluted with 4 or 5 parts of water is suitable. The rich vascularity of the part promotes rapid healing of the lesion.

Fractures. *Etiology.*—The cause of fracture of the horn is violent direct injury of the part, a blow or knock. The fracture may be incomplete, involving only part of the thickness of the horn, or complete, right through the structure. It may be situated near the point, or in the middle part, or in the base of the horn, or beneath the skin in the frontal bone. The direction of the fracture varies. The broken surface is always more or less irregular.

Symptoms.—The fracture is easily recognized, whether it be complete or incomplete. In the latter case the mobility of the distal portion is apparent. When the fracture is in the frontal bone crepitation can be detected, and the whole horn is loose.

Treatment.—The treatment varies somewhat according to the nature of the fracture, as follows :

(1) Fracture of the Distal Third of the Horn. (*a*) Incomplete fracture, the horn and its core being partially severed.—The usual procedure here is to amputate the horn with a fine sharp saw just below the seat of fracture and cover the stump with an antiseptic pad and bandage. Fix the free end of the bandage to the normal horn, and then wind it round the affected one over the pad from base to tip and back again, and fix it to the other horn after crossing the first part of the bandage in a figure of eight fashion. The wounded extremity of the stump may be further protected by a thick layer of cotton-wool placed on it and maintained in position by a cross-shaped bandage whose centre is placed on the pad with its four bands laid longitudinally on the horn and fixed by another circular bandage applied as described. Should it be necessary to conserve the horn entire, as in the case of a valuable show beast, an immobilizing dressing may be applied with a view to bringing about union of the fracture.

The best method of doing this is to apply a special wooden splint adapted exactly to the two horns and to the forehead between them, being slightly grooved to receive the horns on the posterior aspect of which it is placed, and notched transversely to accommodate the wire which is used to fix it to the horns, the fractured appendage being thus maintained in a rigid position until healing takes place. Coculit's apparatus answers this description and is the one usually employed.

(*b*) Complete Fracture.—If the fractured surface is irregular, amputate it and proceed as in (*a*).

(2) Fracture of the Middle Third. (*a*) Incomplete Fracture.—Try and bring about union by the immobilizing apparatus, and if it fail perform amputation.

(*b*) Complete Fracture.—Treat as for No. 1 (*b*).

(3) Fracture of the Base. (*a*) Incomplete Fracture.—If the owner desires to save the horn try immobilization, which is difficult to realize on account of the length and weight of the horn above the seat of fracture, causing leverage and disturbance of the latter. If it fail amputate the horn.

(*b*) Complete Fracture.—Treat as in other situations.

(4) Complete Subcutaneous Fracture.—The frontal bone where the horn is attached is broken. Union may be attempted by the use of the special splint. It is difficult to attain, and if it fail to occur amputation must be resorted to. When compound, treat accordingly. In all cases the wound must be disinfected.

Complication.—The complication of fractures of the horns that may arise is pus in the frontal sinus, which is dealt with under affections of the sinus.

Affections of the Nasal Cavities and Facial Sinuses. Exploration of the Nasal Cavities.—The entrance to the nasal chambers can be readily examined without the aid of an instrument, their middle portion can be fairly well illuminated and explored by reflecting natural or artificial light into it by means of a plane or concave mirror, but the depth of the cavities can only be viewed by means of a special, rather complicated, electrical apparatus known as a rhinolaryngoscope. Probably the best instrument is Leiter's.

Affections of the Nostrils. Contusions.—Contusions of the nostrils are the result of direct violence caused by contact with blunt bodies, as may occur when the animal falls on this part of its head or receives a blow in this situation.

Symptoms.—The symptoms are those associated with contusions in general and usually epistaxis or bleeding from the nose. In severe cases there may be fracture of the nasal bones or of the septum nasi, and the formation of a submucous hæmatoma or collection of blood.

Treatment.—Apply cold and astringent antiseptic lotions to check hæmorrhage and limit extravasation and inflammatory exudate. Recovery is the rule in the course of a few days.

Open Wounds.—The wings of the nostrils in the horse are often wounded by being torn with projecting nails or hooks against which the animal rubs its nose, and by bites from other horses when standing together in lines or in stables with low partitions, especially at feeding time. The wound may be superficial or deep, perforating the nostril. In the latter case, if the lesion is in the form of a cleft its edges will gape widely, and if not sutured will heal separately, leaving a permanent fissure in the nostril. If the cartilage be involved it may undergo necrosis.

Treatment.—Clean and disinfect the wound and bring its edges into accurate contact with

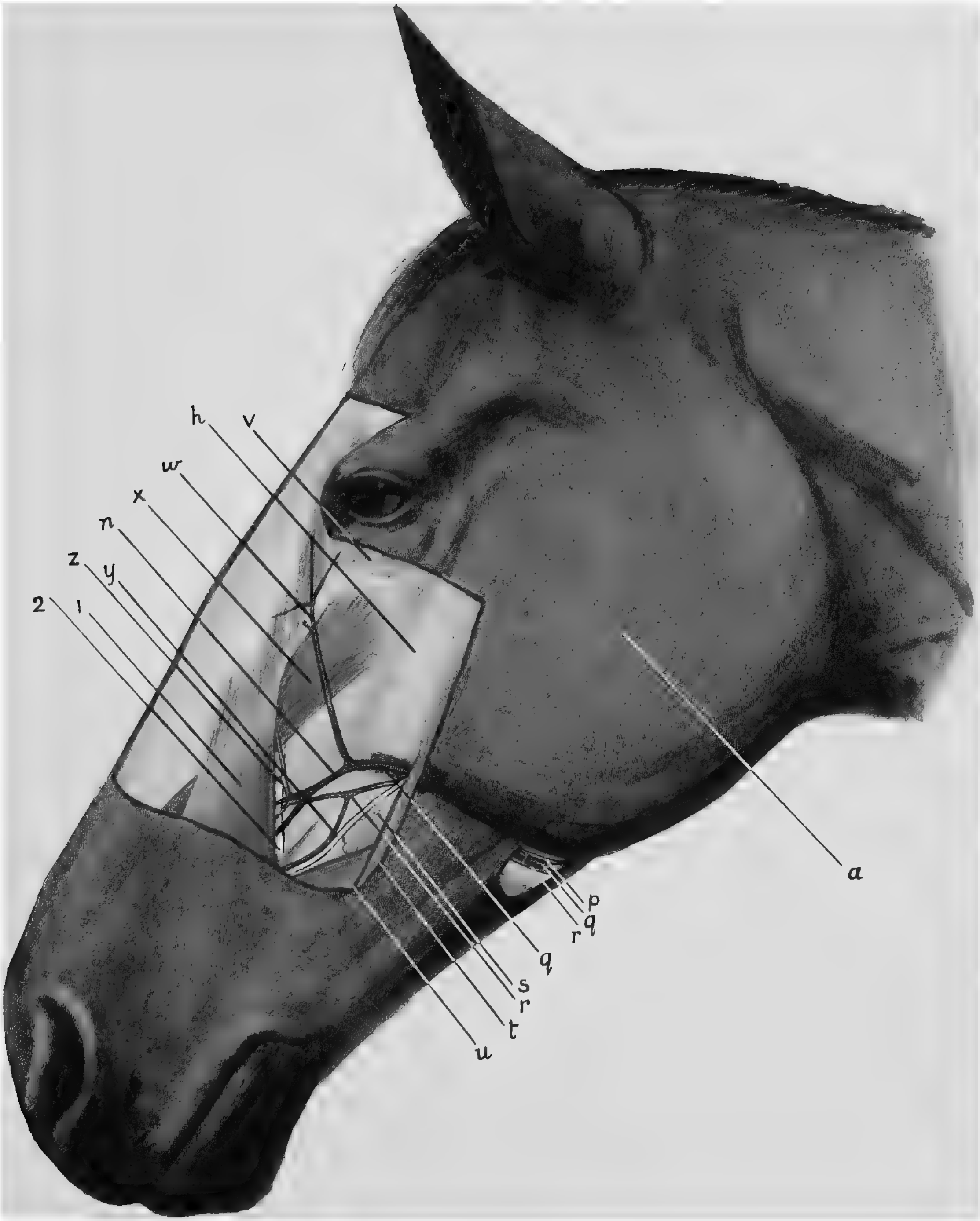

PLATE 3.—SUPERFICIAL DISSECTION.

a, Masseter muscle; *h*, zygomatic ridge; *n*, nasal origin of the submaxillary vein; *p*, Stenson's duct; *q*, submaxillary vein; *r*, submaxillary artery; *s*, superior buccal glands; *t*, zygomaticus; *u*, dilator naris lateralis; *v*, orbicularis palpebrarum; *w*, angular vein; *x*, levator labii superioris proprius; *y*, branch of the facial nerve; *z*, angular artery; 1, levator labii superioris alaeque nasi; 2, infra-orbital nerve.

sutures, the pin suture being very useful as it keeps the lips of the wound immobile and in rigid apposition. Interrupted stitches going right through the wings of the nostril are necessary for perforating wounds.

If the edges of the wound are uneven as the result of laceration causing shreds of dead tissue, remove the latter with scissors, and if the lesion is not recent but granulating freshen it by snipping off the granulations before suturing. Primary union may occur in wounds that have been in existence for several days if they are freshened and sutured, the rich vascularity of the part being very favourable to cicatrization, which always takes place rapidly despite movement and soiling of the part. Apply collodion and iodoform over the line of sutures.

Necrosis of the Cartilage of the Wing of the Nostril.—Necrosis of the cartilage or of the septum nasi of the nostril is indicated by a hard swelling on the inner aspect of the orifice, uni- or bi-lateral according as one or both nostrils are involved, and containing a sinus discharging a greyish pus which may be streaked with blood. The submaxillary lymphatic glands of the affected side are swollen and more or less indurated. On casual examination the case is suggestive of glanders, but on close investigation diagnosis of the lesion is easy.

Prognosis.—There is no tendency to spontaneous cure, and the condition may resist ordinary antiseptic treatment for months.

Treatment.—Aim at removal of the cause by extirpating the necrotic portion of the cartilage by the use of caustics or by operation. Open up the sinus to its depth and swab it with tincture of iodine or a solution of chloride of zinc (1 in 10). This is generally sufficient in a recent case. The surest procedure is to curette or cut out the piece of necrotic cartilage. If the hæmorrhage be profuse it may be arrested by plugging the nostril or by the hot iron. There may be more than one sinus requiring attention.

Oedema of the Head.—Oedema of the head chiefly affects the nasal region.

Etiology.—It may be the result of a wound and infection giving rise to simple or malignant œdema or to erysipelas, or it may be a symptom of a specific disease such as purpura hæmorrhagica in the horse or malignant catarrh in the ox. A dependent position of the head favours the condition.

Symptoms.—The œdema is easily recognized by the great increase in size of the head. There is more or less dyspnœa from encroachment of the swelling on the lumen of the nose, and even asphyxia may supervene.

Treatment.—Treat the condition from which the symptoms arise. In simple œdema resulting from injury raising the head above the level of the body may be sufficient. This may be effected by putting a platform covered with a sack of hay in front of the horse and allowing him to rest his lower jaw on it. Pricking the swelling here and there, with antiseptic precautions, may have a good effect by allowing some of the serum to escape. If suffocation be threatening perform tracheotomy.

Fracture of the Nasal Bones and of the Septum Nasi.—Fractures of the nasal bones are fairly common in the horse and are always due to direct violence, such as falling on the face, colliding with a fixed object, or a kick from another horse.

Symptoms.—The symptoms are those of local traumatic inflammation or contusion, with bleeding from the nose and perhaps deformity. When the lesion is subcutaneous and the swelling is not marked displacement of the fragments may be noticeable, but fractures may occur without displacement. When there is comminution of the bone crepitation can be detected. If the fracture be compound the broken bone is visible. The condition may be complicated with crushing of the turbinated bones, which may afterwards undergo necrosis as the result of infection of the seat of injury.

The septum nasi may be damaged and displaced. In these bad cases there may be dyspnœa from partial occlusion of the nasal chambers. Emphysema may ensue in the surrounding tissues, but is never extensive. Necrosis of the nasal bone may be a sequel to infection in compound fracture.

Treatment.—When there is no displacement treat as a contusion and give antiseptic inhalations to allay inflammation of the nasal mucous membranes. Use cold douches on the face to combat epistaxis, which is usually easily arrested. To reduce a displaced fragment near the nasal orifice introduce a piece of wood guarded with a small pad on its end into the nostril and, using it as a lever of the first order, raise the depressed piece of bone. If it be higher up trephine the bone in its vicinity and perform leverage through the opening thus made. Or the lever may be inserted through an incision at the level of the fracture.

An immobilizing dressing is not necessary. If the fracture be compound treat accordingly. Remove loose spicules of bone, replace attached portions that are displaced, and apply an antiseptic lotion and powder. Treat complications according to their nature. Perform tracheotomy if necessary.

Fracture of the Septum Nasi.—Fracture of the septum nasi occurs as a complication of that of the nasal bones. Its situation is usually in the upper and middle part of the cartilage (the head being horizontal). The structure is more or less crushed and deviated towards one of the nasal chambers. The mucous membrane covering it is lacerated and separated to a variable extent.

Symptoms.—The symptoms are practically the same as those of fracture of the nasal bones. Blood accumulates beneath the mucous membrane on either side of the septum, diminishing the lumen of the nasal passages and causing interference with respiration, which is manifested by a snuffling or snoring noise.

Treatment.—Take measures to arrest hæmorrhage, and reduce displaced fragments. If a hæmatoma persist beneath the mucous membrane, puncture or incise it to allow the contents to escape. Necrosis of the cartilage may result from infection, and must be treated as described.

Tumours of the Nostrils.—Papillomata or warts which are common on the skin of the muzzle in the horse are generally multiple and of small dimensions. They frequently disappear spontaneously when small. Large ones usually persist.

Treatment.—The application of a solution of caustic potash or potassium chlorate causes small warts to wither and drop off. Larger ones may be snipped off with scissors. Those that are too big to be removed in this way can be dissected out with the knife, the operation being easily done in the standing position, under the influence of cocaine, the resulting wound being sutured. When very numerous and of considerable size treatment cannot be undertaken.

Other tumours are rare in the region of the nostrils, and when they are present must be extirpated. Malignant growths are usually incurable. The only chance of success with them is prompt and thorough eradication. Polypoid fibromata occasionally occur in the horse just inside the anterior nares. They may be multiple and then interfere with breathing, causing a respiratory noise when bilateral, and more or less dyspnœa, depending upon the amount of obstruction of the air-passages caused by their presence. They may be removed by the ecraseur or a snare or by the knife. When in clusters they cannot be completely taken away, and the cicatricial contraction which follows their partial excision causes permanent stenosis of the nasal orifice, and if both sides are affected the dyspnœa will be so marked that tracheotomy and the insertion of a tube will be necessary to enable the horse to work.

Cyst in the False Nostril. Atheroma.—A sebaceous cyst may form in the false nostril in the horse, causing a local swelling and a respiratory nasal noise due to encroachment on the nasal passage.

Treatment.—Puncturing the cyst to remove its contents and injecting pure or dilute tincture of iodine may effect a cure after repeated intervention. Incision of the swelling, evacuating it, and swabbing its lining with tincture of iodine or any irritant or stimulating topic such as ammonia or turpentine liniment constitute a more effective method of treatment, care being taken that the irritant does not come in contact with the mucous membrane of the nose. The surest procedure is dissecting out the cyst as if it were a new growth.

Paralysis of the False Nostril.—Temporary paralysis of the false nostril due to loss of function in the dilator naris lateralis muscle is occasionally seen in the horse. When both sides are affected severe dyspnœa or threatening asphyxia may result, from the wing of the nostril falling in towards the lumen of the respiratory passage instead of being drawn outwards during inspiration. It is only during exercise that this distressed breathing is observed. The condition is probably due to injury of a branch of the facial nerve. The treatment is that for paralysis. When the nerve recovers from the injury its function returns.

Traumatic Lesions of Nasal Chamber.—Traumatic lesions of the nasal cavities are associated as a rule with those described in connection with the nasal bones, but in rare instances they are due to the penetration of foreign bodies from the mouth through the floor of the nasal passage.

Injuries of the lower part of the chambers can be recognized through the nostrils, but those of their upper part are only revealed by epistaxis and a nasal respiratory noise. When the turbinated bones or septum nasi are involved necrosis of these structures may supervene.

Treatment.—Treat the lesion according to its nature. Wounds of the nasal cavities usually heal rapidly. Irrigate the passages with a gentle stream of a non-irritant antiseptic liquid like potassium permanganate (1 in 1000). Avoid the use of irritant solutions such as Jeyes' Fluid and take care not to use great force with the syringe for fear of causing the liquid to enter the larynx and bronchi and set up broncho-pneumonia. Insufflation of iodoform is indicated to assist in counteracting infection and preventing necrosis.

Epistaxis.—Epistaxis (bleeding from the nose) may be (1) idiopathic or primary or essential, or (2) symptomatic or secondary. The hæmorrhage may be from one or both nostrils. The mucous membrane of the nasal chambers is very richly supplied with blood, being fenestrated with small vessels superficially situated and liable to be ruptured on comparatively slight provocation.

Etiology. (1) Idiopathic Hæmorrhage.—Occurs without any lesion of the nasal cavity, and the only apparent cause is congestion of the blood-vessels resulting from violent exertion, such as racing, especially when the weather is hot. Appearing under other circumstances it can only be ascribed to some affection of the blood or of the small blood-vessels (hæmophilia, leucæmia).

(2) Secondary Hæmorrhage. — Secondary hæmorrhage is symptomatic of some lesion in the nose, usually of traumatic origin, or due to an ulcerating tumour or to glanders. It may also be caused by irritating dust getting into the nasal cavities, such as that from musty hay, and it has been seen in horses working in lime-kilns, when it is due to finely-powdered lime suspended in the air having a corrosive effect on the blood-vessels of the Schneiderian membrane. Parasites or a foreign body in the nose may cause the condition.

If the hæmorrhage be very profuse or prolonged, or repeated frequently at short intervals, it may prove fatal. Bleeding due to a morbid condition is frequently of a recurrent nature.

Diagnosis.—Epistaxis is distinguished from hæmoptysis or bleeding from the lungs by the blood in the latter case being foamy and always coming from both nostrils, and from the mouth as well in some cases. Moreover, the hæmorrhage in the lungs causes accelerated respiration and dyspnœa, and gives rise to hissing or mucous rales which can be heard on auscultation of the chest.

Hæmatemesis or bleeding from the stomach occurs through the mouth and nose, and the blood appears clotted and blackish like coffee-grounds. When the seat of the hæmorrhage is far up the nose it may be difficult to ascertain the cause of the condition. The rhino-laryngoscope would be useful for the purpose. Mallein can be employed when glanders is suspected.

Treatment.—Apply cold douches to the face, inject hot water or a solution of vinegar or alum or tannin into the nasal cavity. Keep the patient quiet with the head raised, but not to a sufficient extent to enable the blood to flow into the larynx. If the bleeding be from one nostril only and be very profuse plug the cavity at the level of the bleeding part. Attach a piece of tape to a pledget of cotton-wool and push the latter up the chamber just beyond the affected region; then, holding the string with one hand, pack the cavity with more wool. The object of the tape is to prevent the plug going towards the posterior nares and perhaps into the pharynx, and to enable the whole of it to be removed the next day by traction on the string. The free end of the string may be fixed to the nose-band of the head-collar. Another method of inserting a tampon in the nose is to take a fairly large piece of gauze and spread it over the nostril and then push cotton-wool into its centre and up the nose to the required place, the edges of the gauze protruding through the nostril and being held by one hand while the other inserts the plug. If the hæmorrhage be bilateral both nasal cavities of course cannot be plugged without first performing temporary tracheotomy and inserting an ordinary tube or a tampon cannula, the stem of the latter being enveloped in lint or gauze, which prevents the blood passing alongside it into the lungs. Internal treatment is also indicated, giving cold or acidulated drinks, subcutaneous, intravenous, or rectal injections of normal saline or atropine, ergotine, or adrenalin hypodermically.

Necrosis of the Turbinated Bones.—Necrosis of the turbinated bones occurs occasionally in the horse, but is rare in other animals.

Etiology.—The lesion is generally due to strangles with an accumulation of pus in the folds of the bones, but it may also be the result of a wound inflicted directly through the nostril or through the nasal bones, followed by infection of the seat of injury, or it may be a complication of disease of the fang of a molar tooth in its vicinity.

Symptoms.—The symptoms comprise a fœtid, purulent nasal discharge, usually unilateral; interference with respiration, manifested by a snuffling or roaring noise; a swelling in the nasal chamber which may or may not be visible or palpable from the nostril; ulceration and discoloration of the bone, which may be felt rough by the finger if within reach; dulness on percussion of the affected region; and swelling of the submaxillary lymphatic glands.

Prognosis.—When the necrotic portion can be entirely removed cure supervenes. Cast and anæsthetize the patient with the poll at a higher level than the nose.

Treatment.—If the lower third is the portion of the bone involved, make an incision into the nasal chamber extending from the junction of the nasal and premaxillary bones to near the peak of the former, hugging the bone so as to avoid entering the false nostril. Sever the turbinated bone above and below the lesion by means of strong scissors or bone forceps. Seize the isolated portion with a sharp-pronged retractor and, cutting its remaining attachments with scissors, remove it. The hæmorrhage is generally fairly profuse and should be arrested by plugging, as already described. Remove the plug the following day and irrigate the cavity with a mild antiseptic. If the disease is situated in the upper part of the bone, make trephine openings at the level of the affected part, and make them confluent by removing the intervening portions of bone with the bone forceps, thus producing an orifice sufficiently large for the extraction of the necrotic tissue.

Continue the irrigation daily until the discharge ceases and the fœtor disappears. It is also advisable to insufflate iodoform into the nasal cavity. When cure occurs it is effected in about three weeks. Sometimes a recurrence of the condition takes place.

Abscess on the Septum Nasi.—Occasionally an abscess forms on the septum nasi, especially in the horse, due to an open wound and infection, and causing a nasal respiratory noise. If it can be reached by the finger fluctuation can be detected in it, and it will be visible from the nostril. Otherwise diagnosis will be difficult.

The abscess may extend through the cartilage, forming a swelling in each nasal chamber. It may be acute or chronic.

Treatment.—Open the abscess if possible; if not, prescribe inhalations of steam to hasten its maturation and wait until it bursts.

Cyst in the Nose.—Sometimes in the colt or filly a cyst containing a syrupy liquid is found in one of the nasal cavities. It causes a noise during respiration, and may be felt and seen through the nostril. Its wall is thin and may rupture on pressure with the finger. It has been associated with a similar cystic condition in one of the maxillary sinuses. When largely opened by incision or by excision of a portion of its wall and its lining is swabbed with tincture of iodine it disappears permanently.

Foreign Bodies in the Nose.—There are many cases on record of foreign bodies being found in the nasal chambers, gaining entrance through the anterior or posterior nares or through an abnormal communication between the mouth and nose.

Food material may be coughed into the nasal chambers from the pharynx or return this way in a case of dysphagia during an attack of pharyngitis, or in a case of paralysis of the pharynx. Alimentary matter may also reach the nose *via* the maxillary sinus in a case of dental fistula opening into the sinus after the affected tooth has been removed.

The author has reported a case in which the fifth molar tooth became displaced into the nasal fossa in an aged carriage-horse.

In the horse, various things have been found in the nasal chambers which were apparently introduced through the nostrils accidentally or intentionally, such as particles of hay or straw, a piece of sponge, a bit of wood, and strands of tow or wool. Pus may become inspissated in the turbinated bones after a case of strangles, and remain *in situ* indefinitely. A concretion may escape from the guttural pouch through the Eustachian tube and lodge in the nose.

Symptoms.—If the foreign body be large there will be some symptoms of nasal obstruction, characterized by a respiratory noise. The patient may reveal nasal irritation by snorting or rubbing the nose against objects, and when the body has been in position for some time it will give rise to a muco-purulent unilateral nasal discharge. There may be epistaxis. Swelling of the sub-maxillary lymphatic glands is absent unless the case is of long standing. There is no deformity on the face. When the seat of lodgement is near the nostril the object can be seen, but when in the upper part of the chamber it requires the use of the rhinoscope to recognize it.

Treatment.—Remove the foreign body as soon as possible through the nostril, if it is within reach, by means of forceps. If this cannot be done, localize as far as possible the seat of the object, trephine the bone at its level, and extract it through the opening thus made, or insert a sound through the latter and, if practicable, push the foreign body towards the nasal orifice. Particles of hay, straw, wool, or tow must be picked out individually with forceps. A gentle stream of lukewarm boiled water directed up the nose or downwards through an artificial opening in the chamber may serve to dislodge material fixed therein. For this purpose Rey's nasal funnel is useful, as the water ascends one passage and descends through the other.

In the small animals, procedure is much more difficult on account of the small size of the anterior nares. It may be necessary to operate by trephining the nasal cavity.

Parasites in the Nasal Chambers.—The only parasite with which the veterinarian is familiar in the nasal chambers is the *Linguatula tœnioides*, which is almost confined to the dog, being very rarely found in the horse, mule, sheep, and goat. It is very common in the dog in some places, whilst in others it is rarely met with. The parasite may take up its abode in any part of the cavity, but most commonly in the convolutions of the ethmoid, and in the cul-de-sac of the middle meatus.

The dog becomes infested by eating the viscera of herbivora, usually the sheep and rabbit, containing the larvæ of the parasite.

Symptoms.—Frequently the number of parasites present does not exceed two, and then there may be no objective symptoms. When they are more numerous their presence may be revealed by agitation of the host, the dog scratching his nose with his paws, sneezing frequently, and sometimes showing aberrations simulating rabies.

Epileptiform fits may supervene. There may be a mucoid discharge from the nose which is occasionally streaked with blood.

The parasites remain for months in the nose, and eventually die or are expelled, when the symptoms to which they have given rise disappear.

Diagnosis.—Diagnosis is made out by finding the parasites or their eggs, the latter being discovered on microscopic examination of the nasal discharge. The condition may be confounded

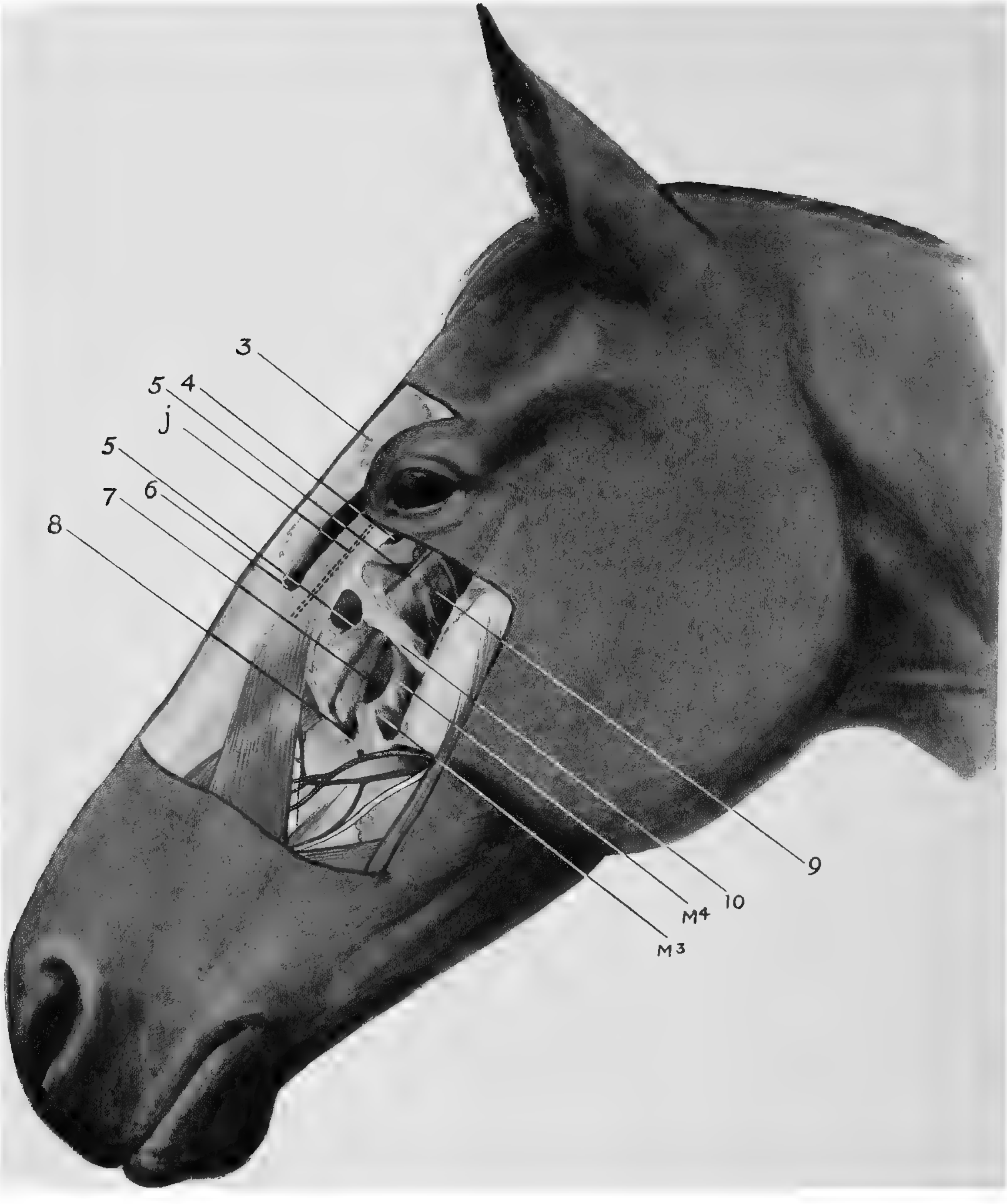

Plate 4.—Deep Dissection.

3, Frontal sinus exposed; 4, communication between frontal and superior maxillary sinus; 5, superior dental canal; 6, lower extremity of the frontal sinus; 7, inferior maxillary sinus exposed; 8, lower extremity of inferior maxillary sinus; 9, superior maxillary sinus opened and exposing alveoli of fifth and sixth upper molars; 10, bony septum between superior and inferior maxillary sinuses; *j*, dotted line indicating position of the osseous lachrymal canal; M^3 and M^4, alveoli containing roots of third and fourth upper molar teeth.

with nasal catarrh, distemper, or rabies. On post-mortem examination exploration of the nasal chambers is indicated when a diagnosis of the cause of death is required under the circumstances mentioned.

Treatment.—Treatment of the symptoms is of no avail while the *Linguatula* remains *in situ.* An errhine such as snuff may be used to make the dog sneeze, with a view to causing expulsion of the pest. It seldom has the desired effect. If the case is alarming, the only thing to do is to trephine the nose and remove the worms.

Slightly irritating injections have been used with some success, for example, dilute solutions of benzine or ammonia. These may be introduced through the nostril or through an artificial opening, their object being to dislodge or destroy the cause of the trouble (see p. 399).

Tumours of the Nasal Chambers.—Most of the common tumours of the body affect the nasal chambers in the domesticated animals, but probably the commonest neoplasms of this region are fibrous polypi. The principal subjects are the horse, ox, and dog. The following new growths have also been found in the nose: papillomata, angiomata, lipomata, myxomata, sarcomata, carcinomata, and adenomata. Dentigerous cysts may be met with bulging into the nasal cavity from the bones of the jaws. Botryomycotic tumours may develop in the nasal fossæ of the horse, but they are very rare. Actinomycotic enlargements frequently encroach on the nasal passages in the ox.

Diagnosis.—Diagnosis is easy when the tumour is well developed. The following symptoms are usually observed: a mucoid or muco-purulent discharge, epistaxis, not constantly present, more or less complete obstruction of the narial passage causing a respiratory bruit and deformity of the face due to bulging of the nasal bones. If the neoplasm be malignant it may be ulcerating externally, and the submaxillary lymphatic glands may be enlarged by the formation of secondary growths when the primary one is a carcinoma.

Microscopic examination of a section of the tumour will reveal its nature, whether it is malignant or benign.

Treatment.—Malignant tumours are incurable. It is useless to operate to remove them. Benign tumours, if fairly circumscribed, are amenable to treatment. They may be excised through the nostril, or through an opening to the inner side of the false nostril, or through a breach in the upper part of the nasal bones, depending upon the situation of the neoplasm. Pedunculated tumours can be extirpated by means of the ecraseur or by ligation, the tumour being cut off on this side of the ligature, the stump afterwards sloughing away. The procedure for operation is similar to that described in connection with diseased turbinated bones. Cast the horse and, if respiration is not much interfered with, administer chloroform. Keep the poll raised so that blood will escape through the anterior nares instead of passing backwards into the larynx and causing, perhaps, suffocation.

If there is much obstruction of the nasal chambers perform tracheotomy, and insert a tube or tampon cannula before operating on the tumour.

Hæmorrhage near the nasal orifice may be arrested by the hot iron at a dull red heat. Further up the nose plugging will be necessary (epistaxis).

If benign tumours are multiple and their removal is impracticable, the usefulness of the horse may be prolonged by putting a tube in the trachea to facilitate breathing.

Affections of the Sinuses.—Traumatic lesions, including contusions, often wounds and fractures of the bones of the facial sinuses, are almost identical with those of the nasal bones and must be dealt with accordingly. Lesions of the sinuses and nasal cavities often coexist. Rarely the cranium and brain are involved in injuries of the frontal sinus. The prognosis of these affections, without complications, is usually good. The accumulation of blood in the sinus favours the proliferation of organisms therein, which may cause suppuration and a collection of pus in the cavity, necessitating further intervention as described later.

Pus in the Sinuses. Sinusitis. *Etiology.*—The causes of pus in the sinuses may be primary or secondary.

Primary Causes.—The primary causes are injuries of the walls of the sinuses, viz. contusions and open wounds, causing bleeding into the cavities, where pyogenic organisms may then multiply and cause suppuration, the pus accumulating owing to the want of a dependent orifice.

The prolonged sojourn of the pus in the sinus brings about chronic inflammation of its lining and may lead to necrosis of the turbinated bone, which then acts as a secondary cause.

A spicule of bone in a case of comminuted fracture may fall into the sinus and act as a foreign body, or the latter may gain entrance from the nasal cavity in the form of alimentary matter coughed up from the pharynx.

Secondary causes comprise dental affections associated with suppuration of the alveoli of the teeth with perforation of their walls into the sinus; malignant tumours involving the sinuses; *Œstri ovis* in the frontal sinus of the sheep; and injuries of the horns in cattle as described.

Symptoms.—The first symptom to attract attention is nasal discharge, which at the commencement of the affection is of a muco-purulent, non-offensive nature, but when it is well established it is purely purulent and very fœtid. The pus is greyish, often contains yellowish-white coagula, and may occasionally be streaked with blood, which may be an indication that the bone is ulcerated. The discharge is usually unilateral, one sinus only being affected as a rule, and it is constantly escaping. It is more copious during exercise, due to the movements of the head and the increased respiration causing rapid currents of air to pass through the sinus and force out more pus. The submaxillary lymphatic glands become swollen after some time but remain movable under the skin. If the sinus be distended with contents there will be a swelling at its level, and when the cavity is full of fluid there will be dulness on percussion, which may also cause a little pain as shown by the resentment of the animal. There is seldom constitutional disturbance, but when the affection is of long standing the subject is generally somewhat unthrifty and more easily tired and sweated than usual. There may be some lachrymation of the eye of the affected side, and a clot of mucus may lodge in its inner canthus.

Diagnosis.—The condition must be distinguished from affections of the nose, which are usually accompanied by a respiratory noise due to swelling therein and from glanders, which can be eliminated by the use of mallein. Positive diagnosis can be made by exploration of the sinus through an opening made by a gimlet or a trephine, preferably the latter, as it makes a larger aperture. When the gimlet is employed the pus may be seen in the groove of the instrument.

The characteristic features of pus in the guttural pouches and tumours of the nose, dealt with elsewhere, will serve to exclude them in considering the nature of the case.

Prognosis.—The prognosis should generally be guarded, for, although the condition is not dangerous, it is often difficult to say whether it will recur or not after apparent cure. When the result of an injury which has not damaged the bones to an appreciable extent, rapid cure is the rule with simple treatment. When due to secondary causes, recovery depends on removal of these, and when this is not thoroughly carried out there is sure to be a recurrence of the malady.

Treatment consists in evacuating the sinuses of the pus, irrigating them with a mild antiseptic solution, and removing the cause of the affection if possible.

To evacuate a sinus it is necessary to make an opening in its lower part by means of a trephine. It is also advisable to trephine its upper portion to enable the cavity to be flushed out from above.

Operation of Trephining. *Horse.—Control.*—The operation may be done standing, under the influence of cocaine or, if necessary, the animal may be cast on the opposite side and local or general anæsthesia employed. After the cutting of the skin the patient seems to suffer little pain when no anæsthetic is used.

Site of Operation. 1. *Frontal Sinus.*—There are three sites, viz.:

1. To reach the upper part of the sinus take a line joining the middle points of the roots of the supra-orbital processes, bisect it by a vertical line, and operate in the inferior angle of intersection of the lines.
2. To enter the middle part of the sinus operate midway between the inner canthus and the mesial suture.
3. To get into the lowest part of the sinus take a line joining the nasal canthus and the point of junction of the nasal and premaxillary bones, take 2½ inches down on this line, and operate 1 inch in front of this point (Craig).

Superior Maxillary Sinus.—Operate at a point 1½ inch upwards from the lower end of the zygomatic ridge and 1 inch inwards towards the middle line. In young horses it is well to go a little further inwards to avoid the fangs of the molar teeth, which are longer in the young than in the old animal. The sinus is larger in the aged than in the youthful subject.

Inferior Maxillary Sinus.—Take 1 inch inwards from the lower end of the zygomatic ridge and operate at that point.

Procedure.—Having shaved and disinfected the skin, make a circular incision through it down to the bone, isolating a disc of skin and subcutaneous tissues having a diameter equal to that of the crown of the trephine.

Remove the tissues within the incision, completely exposing the bone. The periosteum may be scraped off the latter with a curette. Have the centre-pin of the trephine projecting beyond its cutting edge and insert it into the hole made with a gimlet in the centre of the exposed bone. Working the instrument with a to and fro circular movement, saw through the latter. The detached disc of bone usually comes away inside the crown of the trephine. Should it drop into the sinus remove it with a forceps at once or it may be lost.

Having made an opening at the upper part of the frontal and the lower part of the superior maxillary sinus, irrigate the cavities, which are in free communication, with a non-irritant antiseptic solution not too forcibly injected for fear of its entering the lungs, *via* the nose, such as permanganate of potash (1 in 1000), hydrogen peroxide (1 in 10), or tinct. iodine 1, potass. iod. 5, water 100, etc. Later, an astringent lotion may be useful, viz. sulphate of zinc (1 or 2 in 100). Iodoform may also be insufflated. Keep the

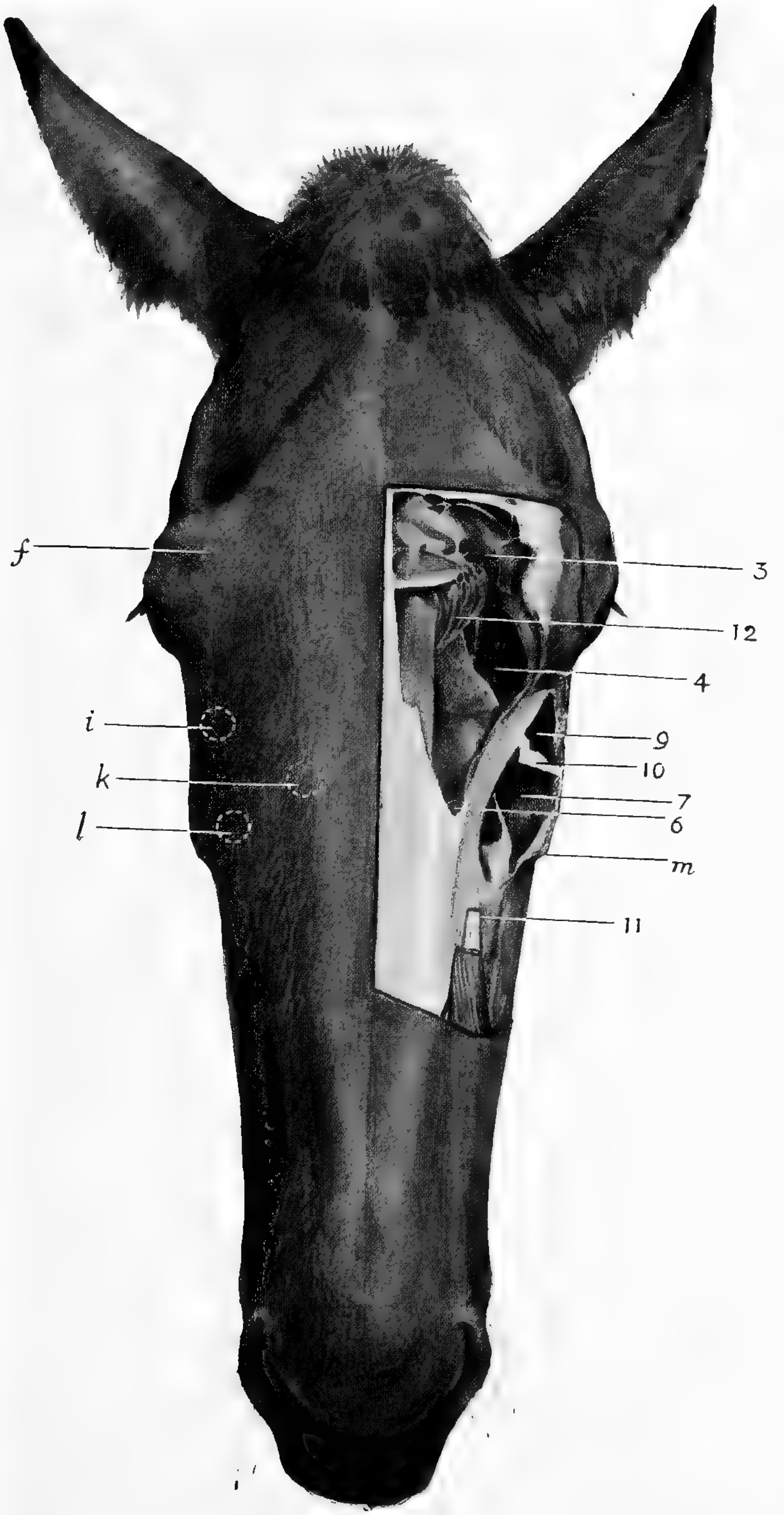

Plate 5.—Front View.

f, Supra-orbital process of the frontal bone; *i*, position of trephine-opening into superior maxillary sinus in empyæma; *k*, position of trephine-opening into the lower extremity of the frontal sinus; *l*, position of trephine-opening into the inferior maxillary sinus in empyæma; *m*, lower extremity of zygomatic ridge; 3, frontal sinus exposed; 4, communication between frontal and superior maxillary sinus; 6, lower extremity of the frontal sinus; 7, inferior maxillary sinus exposed; 9, superior maxillary sinus opened and exposing alveoli of fifth and sixth upper molars; 10, bony septum between superior and inferior maxillary sinuses; 11, infra-orbital nerve issuing from the infra-orbital foramen; 12, ethmoid bone (lateral mass of).

openings patent by plugging them with antiseptic tow or cotton-wool or with pieces of cork perforated in the centre to allow escape of discharge. A piece of stout rubber-tubing may also be used for this purpose. Continue the dressing daily until the discharge ceases and the offensive smell disappears. Then omit the plugs from the openings and allow them to close. When this affection of the sinus is secondary to another condition, take measures to deal with the latter according to its nature.

The frontal and superior maxillary sinuses may be drained through the inferior maxillary sinus by breaking the thin bony septum between the maxillary sinuses by means of a chisel or punch. When the cause of the condition is obscure it is wise to open the inferior maxillary sinus, as it may be discovered there in the form of a diseased fang from which infection has spread through the bone into the upper sinus. When the cause is removed and free drainage is produced cure is generally effected within a month.

Those lesions from which empyema of the sinuses may arise will be treated in the sections to which they belong (Tumours, Affections of Teeth, etc.). A piece of bone around the opening may undergo necrosis and be accompanied by inflammatory swelling of the overlying skin. After a while it exfoliates and causes no further trouble. Rarely, a portion of bone in the depth of the sinus becomes affected in this way and prevents healing until it is removed.

Operation in the Ox.—*Frontal Sinus. Control.*—Standing or cast position.

Site.—Operate in the superior angle formed by the lines mentioned in the case of the horse, taking care to avoid the supraorbital artery which occupies the supraorbital fissure. The opening in this situation is dependent. The upper part of the cavity can be entered through the base of the horn or by removing the latter, or at a point about one inch below the level of the horn. This sinus does not communicate with the maxillary sinus but has full communication with the nose by a number of openings.

The procedure and after-treatment are the same as in the horse.

Cold douches should be avoided as they seem to favour inflammation in the sinuses and may give rise to it in the normal cavity.

Maxillary Sinus.—Operate immediately above the maxillary protuberance.

Operation in the Sheep.—*Frontal Sinus.*—Operate in the same position as in the horse.

Tumours.—Tumours of the sinuses are fairly common in the horse and comparatively rare in other animals. They may be primary, taking origin in the sinus, or secondary, extending thereto from neighbouring parts, viz. the nose, mouth, or pharynx. The new growth may be a cyst, a myxoma, an osteoma, a fibrous polypus, a sarcoma, or a carcinoma.

Symptoms and Diagnosis.—Diagnosis of a tumour affecting the sinus is easy, but it may be difficult to say whether it is confined to it or involving neighbouring regions as well. It is recognized by deformity of the face, and by a muco-purulent or purulent discharge from the corresponding nostril. There may be epistaxis.

Examination of the mouth and nose may reveal whether these cavities are affected or not. Nodular enlargement of the submaxillary lymphatic glands indicates that the neoplasm is a carcinoma. When the tumour is malignant the bone over it is destroyed, ulceration may take place, and the centre of the neoplasm may become necrotic and putrefy, giving rise to a stinking, dark-red, semi-liquid discharge.

Prognosis.—The prognosis is nearly always grave because, although the tumour may be benign, it is generally impossible to eradicate it thoroughly without encroaching on the important regions in the vicinity and causing perhaps irreparable damage. If, however, the tumour is decidedly circumscribed or polypoid it can be successfully removed. When the disease is malignant cure is out of the question.

Treatment.—Complete extirpation of the tumour is the only effective treatment. The procedure consists in thoroughly exposing the tumour by removing the bone which covers it and then eradicating it. Remove a piece of skin about the size and shape of a five-shilling piece at the seat of operation, and reflect the remaining skin over the sinus by dissection if a larger breach in the wall of the cavity is necessary. Using a large trephine, make three trephine openings in the bone at a tangent to each other. Break down the intervening bridges of bone with bone forceps.

If the orifice thus made in the sinus is not sufficiently large to enable the tumour to be eradicated, enlarge it further by removing pieces of bone at its periphery with the forceps. Make the edges of the aperture smooth by the aid of a bone-scraper.

Dissect out the tumour or remove it piecemeal. When it is an osteoma it may be necessary to trephine it in sections, isolating cylinders of bone, which are detached separately by the use of a chisel and mallet.

If the tumour be pedunculated its excision is simple, but if it be wide-based it will be difficult to remove every trace of it. The curette may be required to scrape the interior of the sinus.

Hæmorrhage is usually more or less profuse, and measures may be necessary to arrest it before the operation is finished by plugging the cavity or applying the hot-iron. Two or more séances at an interval of one or two days may be necessary when the tumour is large and vascular. Ordinarily the operation wound heals completely in the course of four to six weeks, but occasionally, when the breach in the wall of the sinus is very large, it fails to close entirely, a permanent aperture remaining in the bone over which a piece of leather, suspended from the bridle, may be placed as a protection when the horse is at work.

Dentigerous cysts are sometimes found in the sinus of the young horse, and must be treated by extirpation of the cyst-wall and its contents. Evacuation of its contents and destruction of its lining by swabbing with pure tincture of iodine may have the desired effect.

After operating, the wound should be dressed daily with an antiseptic solution and antiseptic powder.

Foreign Bodies.—Foreign bodies in the sinuses are not common. They may be inspissated pus, spicules of broken bone, alimentary matter gaining entrance through a breach in the floor of the sinus following the repulsion of a molar tooth or through a dental fistula communicating with the mouth, bits of wool or tow which had been used as plugs in trephine opening, and bits of shrapnel or shell-casing. Smooth, clean, foreign bodies that have entered the sinus without causing much damage to the tissues may remain *in situ* without causing much trouble beyond a little mucous discharge from the nose. Otherwise they set up the condition of " Pus in the Sinus," when the treatment for the latter condition must be adopted and the foreign body removed. When the sinus becomes filled with alimentary material which has come from the mouth through the empty alveolus which is communicating with the air-cavity, it will be necessary to evacuate the sinus and plug the alveolus with gutta-percha to prevent recurrence of the condition. If the abnormal passage between the two cavities be recent it may be sufficient to plug its upper part with gauze until its oral portion becomes closed by granulations.

Parasites.—The parasites found in the sinuses are the *Linguatula* in the frontal sinus of the dog, and the larvæ of the *Œstrus ovis* in that of the sheep.

The favourite habitat of the *Linguatula* is the nasal chambers of the dog, but occasionally it develops in the frontal sinus. The latter cavity is the predilection site of the *Œstrus ovis*, but in rare instances it infests the maxillary sinus.

The number of larvæ present in the sinus of the sheep is ordinarily two to six, but upwards of fifty have been found in it. Except a large number exists in the sinus there may be no symptoms betraying their presence. When they cause trouble there is a mucoid discharge from the nose, sneezing and snorting, and the animal rubs the nose with the claws or against a fixed object. Phenomena resembling those of sturdy may supervene.

Prevention.—Preventive measures comprise the use of agents for keeping the flies at bay, such as tar smeared on the nostrils, and the destruction of the larvæ.

Treatment.—Treatment is not very satisfactory. Drugs are of little use in destroying or dislodging the parasites except introduced directly into the sinus after trephining it. Benzene diluted with water and injected into the sinus is sometimes successful. Those that can be reached may be removed mechanically with forceps. The method of dealing with the *Linguatula* in the dog has been described in connection with affections of the nasal chambers.

Affections of the Jaws. Fracture of the Superior Maxilla.—Fracture of the superior maxilla is caused by direct violence as may result from a fall or a collision, or the animal striking the head violently against a hard, fixed object. It may be accompanied by fracture of other bones of the skull. The seat of fracture may be the palatine plate or the alveolar border.

Symptoms.—The following symptoms may be observed : deformity due to inflammation, and displacement of fragments ; hæmorrhage from the mouth and nose ; crepitation ; salivation ; and interference with mastication.

Prognosis. — When the fracture is simple rapid cure usually takes place. When compound it may also heal without complication, or infection of the wound may lead to pus in the maxillary sinus or necrosis of that bone, and if the alveolus of a tooth be involved dental fistula may supervene. General infection or toxæmia may arise when the wound is contaminated by very virulent organisms.

Treatment.—The treatment is that for contusion or open wound and fractures in general. If there be neither a wound nor displacement no special intervention is required. Loose teeth may become fixed in a few days, and therefore should not be removed until suppuration occurs in their alveoli. Semi-liquid diet should be given which will not require mastication. If there be a wound in the mouth wash out the cavity after feeding to prevent food material lodging in the wound. Slight depression of fragments is of no consequence. In a bad case of compound comminuted fracture it may be necessary to cast the horse to remove loose spicules of bone, reduce displacements, and dress the wound. Trephining may be required to allow of leverage of a depressed fragment.

An immobilizing dressing is not essential, as a rule, but strips of adhesive plaster or bands of calico smeared with melted pitch may be applied across the face to maintain fragments in position. The head-collar should be left off, and to prevent the horse knocking the injured part against the manger he may be kept in a stall tied by the pillar-reins fixed to a strap round the neck, and fed from a trough or pail placed at a convenient level and removed after feeding, when a tight nose-band may be used to keep the jaws at rest. Complications are to be treated according to their nature.

Fracture of the Premaxilla.—The premaxilla may be fractured by the horse falling forward on its nose or by receiving a kick from another horse in this region when the head is lowered. The fracture may be transverse or longitudinal or both, uni- or bilateral, and simple or compound, usually the latter.

Treatment.—Treatment is on general principles for wounds and fractures. A stout piece of stick may be used to push the displaced fragment into position, holding it by the two ends and pressing its middle part against the bone, the horse being in the cast position. When the displacement is inwards towards the mouth the stick may be used as a lever of the first order to raise the depressed bone.

Retention is best effected by means of silver wire wound round the teeth of the two premaxillæ, whether the fracture be transverse or longitudinal in direction. When there is displacement upwards of both bones wire may be fixed to the incisors and to the first molar on either side, a hole being bored by means of a drill between the latter and the second molar to accommodate the wire. A niche should always be made with a file on the corner incisors to prevent the wire slipping. The canine teeth may also serve as points of support for the wire. If fixation of the teeth be not sufficient, the bones may be sutured with wire passed through holes made with the drill. The severed mucous membrane should also be united by sutures, and care should be taken that a portion of it does not become insinuated between the fragments and prevent their union. Dress the external wound, when present, in the usual way. Remove loose spicules of bone. Some of the incisors may be broken. Projecting points should be removed with a file. Loose teeth should not be removed at once. They may become fixed again after a few days; if not, they should be then extracted. Wash out the mouth after meals with a mouth-wash. Give suitable diet requiring little mastication. The case usually makes a good recovery. Should necrosis of the bone supervene and union fail to occur, the loose fragment may be removed.

Fracture of the Inferior Maxilla.—The inferior maxilla may be fractured by kicks, falls, or direct violence of any kind, and also, though rarely, by violent muscular effort, as has been known to occur from excessive contraction of the masseter muscles when a gag was placed in the mouth of the horse.

Repulsion of a tooth may cause the bone to fracture. In the dog it may be fractured by the vigorous movement of the hind limb of a beast or stag which it has seized in its jaws. Occasionally the lower jaw of the fœtus is fractured as the result of severe traction on a hook fixed in it during delivery. The site of fracture may be the body, one or both rami, the condyle, or coronoid process of the bone.

The direction of the fracture in the body may be longitudinal, transverse, or oblique. The fracture may be simple or compound, usually the latter. In either case it may be comminuted.

Treatment.—Treatment is carried out on similar lines to those laid down for fractures of the premaxilla.

1. **Fracture through the Symphysis.**—Occurring in young animals. Replace the fragments in their normal position and maintain them there by joining the teeth on either side by wire. An alternative but less satisfactory procedure, in the dog, is to fix the two jaws together by means of a bandage and feed the animal artificially with liquid food introduced at the commissure of the lips or through an œsophageal tube.

2. **Fracture through One Side of the Body.**—After reduction wire the teeth as before, if those of the affected side are sufficiently intact for the purpose. Otherwise, the bones may be united by metallic sutures.

3. **Transverse Fracture through the Body or through both Rami near the Symphysis.**—In this case the separated fragment is displaced downwards and it is difficult to keep it in place after reduction. Wiring the incisors to the first molars may be useful in conjunction with an apparatus in the form of a V fixed to the lower jaw, the apex of the V being spoon-shaped to support the chin, and its branches being grooved to adapt themselves to the horizontal rami. The parts in contact with the skin are padded and the apparatus is kept in position by padded straps over the face and poll. For small animals a device of this nature made in gutta-percha may prove satisfactory.

The objection to all these dressings is that they become displaced, cause excoriation of the skin, and interfere with mastication. A false joint may supervene owing to fibrous union taking place between the fragments.

Wire sutures through the bone are the best means of immobilizing the seat of fracture. Should every method fail to bring about union, or necrosis of the loose piece of bone supervene, the latter may be amputated. Bouley records successful amputation of the body of the bone in a horse (*Recueil de Med. Vet.*, 1838).

4. **Fracture of one Ramus.**—This requires no treatment, there being practically no displacement. Even when compound and comminuted

recovery usually takes place. The vertical ramus may be fractured along with the horizontal ramus, and healing take place in both lesions. When required, it is usual to apply a blister or a pitch-plaster on the skin at the level of the fracture. The blister causes swelling and inflammation which have an immobilizing effect, and brings about hyperæmia, which hastens the healing process. The pitch-plaster also tends to immobilize the part. If the fracture be compound or comminuted treat accordingly. When there is a wound in the mouth it must be kept clean, especially after meals.

In all cases of fracture of the jaws, soft, easily masticated food is indicated.

Fracture of the coronoid process or condyle is rare. Fibrous union occurs in the former case and anchylosis of the joint is apt to supervene in the latter.

Contusion. Sinus. Fistula.—Contusions of the jaws are inflicted in the same way as fractures. They may give rise to osteo-periostitis. A common seat of injury is the inferior maxilla, where it is usually due to striking the jaw against the manger. The lesion in this case is not of an acute nature, as a rule, being gradually produced by repeated slight knocking of the posterior border of the bone against the edge of the manger, and assuming the form of an exostosis. The same condition may be caused by the constant use of a head-collar with a tight nose-band. Should infection gain entrance into the injured part necrosis of the bone may supervene and purulent osteomyelitis may extend to a variable depth. The sinus which results may abut on the fang of a tooth, constituting a form of dental fistula.

The base of the mouth may be injured by the bit, the bone becoming affected with acute osteo-periostitis, which frequently becomes septic from organisms penetrating through the abraded mucous membrane and causing necrosis of a shell of bone, which soon becomes loose and may fall out if it is not taken away. The disease may extend through the bone, causing a fistula opening on the posterior border of the jaw.

Symptoms.—The symptoms are those of acute or chronic traumatic inflammation or of a sinus or fistula in the bone. When an exostosis is present on the posterior border of the lower jaw it is easily recognized. A sinus in the bone is characterized by a suppurating orifice surrounded by a hard inflammatory enlargement. A probe passed into it comes in contact with the rough bone and may reveal a loose portion, or it may abut on the fang of a tooth, or it may be pushed into the mouth when there is another opening there. There may be a cavity in the bone filled with thick pus.

Treatment.—Alter the manger or the method of feeding the horse. Discontinue the use of the bit until the mouth lesion heals and then use a rubber bit if the horse is a puller. Apply antiphlogistic measures for inflammation. Remove the sequestrum from the wound in the mouth when it is loose. When there is a sinus externally remove an elliptical piece of skin round its orifice. Enlarge the latter, remove loose pieces of bone, and curette the lining of the passage to its depth, paint it with tincture of iodine, dust it with iodoform, and plug the cavity with gauze. Remove the plug the following day and treat subsequently as an open wound, continuing the application of the iodine and iodoform until the cavity is found to be healing, when dry dressing will be sufficient. Although an offensive discharge persists for some days after the operation, cure is usually uninterrupted even in cases where the fang of the tooth is exposed.

If the exostosis is small and has a narrow base it can be easily removed by means of a chisel and mallet or fine saw. If it be large it is better to leave it alone. **Open wounds** of the jaws are only of special interest in that they may be accompanied by contusion and infection with the results just described, viz. suppuration and necrosis.

Tumours.—What has been said about tumours of the sinuses applies in a general way to those of the upper jaw, which is more commonly affected than the lower jaw. Neoplasms of the jaws are fairly frequently met with in veterinary practice, especially in the horse and dog. In the ox actinomycotic tumours are very common. The following varieties may be found affecting the maxillary bones:

1. **Dentigerous cysts,** which are slow in development and may persist for a long time without causing inconvenience; but occasionally they suppurate, causing necrosis of the bone and sinus formation.
2. **Fibromata,** most common in the dog, growing on the surface of the alveolar border. They may undergo calcification or ossification.
3. **Chondromata,** hard subperiosteal tumours, uniform or bosselated on their surface, slow in development, and having little tendency to spread to surrounding parts.
4. **Sarcomata,** developing in the substance of the bone or beneath the periosteum, growing and extending rapidly, accompanied by ulceration of the skin and mucous membrane, and interfering with respiration or mastication or both according to their situation. They often cause loosening or shedding of the teeth, hæmorrhage from the mouth or nose, and may become generalized, causing cachexia and death in a short time. The submaxillary lymphatic glands are seldom involved.

They affect animals of every age and are most common in the dog.

5. **Carcinomata** are almost confined to adult, and especially aged, subjects.

They are more common than sarcomata in the horse. They are characterized by the rapidity of their evolution, by a fœtid, purulent nasal discharge when the upper jaw is affected, by destruction of the bone, its place being taken by the tissue of the tumour, by ulceration of the skin in the later stages of the disease and a discharge of a very offensive liquid of a dark red colour mixed with pus from the centre of the growth, by loosening and eventual shedding of the teeth in the affected region, and ultimately by enlargement of the submaxillary lymphatic glands due to invasion by the neoplasmic elements.

When some of the teeth are shed there is also a stinking discharge from the mouth. When the swelling has burst or is opened fungoid granulations form in the wound.

Treatment.—If benign tumours are small and circumscribed extirpate them completely as described (Tumours of the Sinuses).

Actinomycotic tumours are dealt with in the article on "Actinomycosis."

It is useless to intervene for malignant neoplasms.

Affections of the Temporo-Maxillary Articulation.—Contusions of this joint are the same as those of other articulations. They may cause synovitis, which interferes with mastication owing to the pain caused by movement of the joint. They respond to the ordinary methods of treatment. Rarely an osteo-periostitis supervenes, causing the formation of an exostosis and anchylosis of the articulation.

Open Wounds.—Open wounds in the vicinity of and sometimes those penetrating the joint heal easily under antiseptic treatment. The prognosis, however, must be guarded when the joint is open, as there is always the risk of infection gaining entrance and causing septic arthritis and destruction of the articulation, with perhaps fatal consequences owing to the patient being unable to masticate.

The treatment of penetrating wounds of the joint, which are recognized by the escape of synovial fluid, is on the same lines as those recommended for synovial fistulæ in general. In short, it comprises strict antisepsis and immobilization of the joint as far as possible. When the case is chronic and the fistula shows no tendency to heal, the cauterization of the borders of its orifice or the application of a blister of biniodide of mercury (1 in 8) to the wound and its vicinity, or point-firing the latter generally, has the desired effect. A little powdered perchloride of mercury applied to the wound is often very effective, causing a scab under which healing takes place. Easily-masticated food should be given.

Arthritis.—Dry arthritis of the joint has been seen in the horse and dog. Moller records a case in the dog in which both articulations were affected.

Symptoms.—The affection is characterized by difficulty in mastication and, usually, by hard painful swelling at the level of the joint. Occasionally there is little alteration externally. Crepitation may be detected, due to the friction of the ulcerated articular surfaces of the bones.

Treatment is useless when the joint is disorganized. Counter-irritation by blistering or needle point-firing may be tried in the hope that repair is possible, that the lesion has not gone beyond the stage of chronic synovitis.

Dislocations.—Dislocation of the joint is not common even in carnivora. It would seem to be impossible in herbivora without fracture of the long coronoid process, yet cases of it in the horse and ass have been recorded by continental veterinarians. In this country we are only familiar with the condition in the dog. The displacement is almost always forwards. It occurs in the dog as the result of the animal seizing a large object with its jaws, in the staghound from the stag violently snatching its hind limb from the grasp of the dog's mouth, and in the sheep-dog similarly from biting the hind limb of an ox.

Symptoms.—The mouth remains wide open, the lower jaw being dropped and fixed rigidly in this position. Saliva trickles from the mouth, and the tongue is pendulous. Prehension is impossible. There may be exophthalmia owing to displacement of the coronoid process into the orbit. If the luxation is unilateral the jaw will be depressed and deviated from the affected side.

Diagnosis.—It is distinguished from paralysis by the jaw, in the latter case, not being fixed but capable of being passively lifted.

If the paralysis be rabiform there will be other symptoms or a history to guide the clinician.

Treatment.—Reduction of the dislocation is effected by two movements: (1) pushing the inferior maxilla downwards so as to bring the opposing articular surfaces on a level; and (2) pushing the bone backwards into its normal position.

It can be done by placing a stout piece of stick crosswise in the mouth as far back as possible between the molars and then forcibly bringing the jaws together.

In the dog it can be accomplished by the hands alone, by grasping the lower jaw with each hand with the thumb, protected by a glove finger or cloth, resting on the alveolar border and the fingers grasping the horizontal ramus and first depressing the jaw posteriorly and then pushing it backwards.

The operation is facilitated by general anæsthesia, which is necessary in the large animals. To prevent recurrence give soft or liquid diet only for a few days.

Affections of the Mouth.—*Exploration of the Mouth.*—In order to explore the horse's mouth proceed as follows :

1. *Without the Aid of an Instrument.*—Have the horse backed into a corner or a stall with plenty of light in front. Pass the left hand into the interdental space on the right side and, catching the tongue gently but firmly, draw it out at the side of the mouth. Pass the thumb of the right hand inside the cheek at the commissure of the lips and draw it outwards so as to expose the gums and teeth on this side. Reversing the hands, examine the other side of the mouth in the same way. To make the horse open the mouth wider for a general view of the cavity, press on the hard palate with the thumb of the right hand.

In the ox a similar procedure is adopted, the beast being well held by an assistant grasping a horn with one hand and having the fingers and thumb of the other hand in the nostrils.

In the dog, held by an assistant and prevented from going backwards, pass the right hand under the throat with the latter between the fingers and thumb and grasp the lower jaw in order to steady the head. Pass the left hand gradually down the face and, pushing the upper lip inwards on either side beneath the upper jaw, grasp the latter with the fingers and thumb and, releasing the hold with the right hand, use it to depress the lower jaw by placing the thumb on the inner aspect of the incisor teeth.

In the cat the mouth is opened by separating the jaws by means of the two index-fingers applied to the upper and lower incisors.

2. *Using an Instrument.*—To keep the jaws separated in the horse use a speculum oris or mouth-gag, of which there are various patterns on the market. The simplest form consists of a vertical and two horizontal bars, the latter being introduced transversely into the mouth and affording sufficient room between them for the passage of the hand, the tongue being held out of the mouth by an assistant as described.

The improved varieties are capable of being adjusted by means of a screw regulating the distance between the horizontal bars. Most of them have the defect of hurting although not seriously injuring the roof and floor of the mouth, causing bleeding in some cases even when covered by india-rubber. Probably the best gag is the "Revelation Mouth Speculum," in which the parts in the mouth are in the form of plates adapting themselves exactly to the upper and lower incisor teeth, on which all the pressure is borne without discomfort to the patient. A raised border in front prevents the plate slipping. Each plate is jointed to a cheek-portion on each side. The upper and lower cheek-portions are jointed posteriorly, moving on a horizontal axis, and are capable of being fixed at any required distance from each other by means of a ratchet. The instrument is fixed in position by the aid of a strap over the poll and straps round the jaws. It is introduced with the upper and lower portions in contact, and after insertion they are separated by pushing the jaws apart, the action of the ratchet preventing their closure; or they may be separated by a screw for the purpose. Special plates covered with leather to rest behind the incisors can be used when it is necessary to have the latter exposed or when the instrument is employed for the ox.

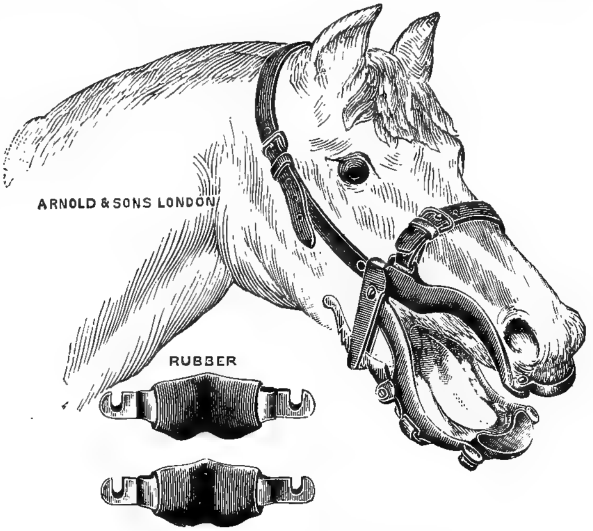

FIG. 190.—Mouth speculum.

A useful gag for keeping the jaws apart for a cursory examination of the mouth and for simple dental operations is one in the form of two metal plates joined at one end in a V-shaped fashion, denticulated on their surfaces and provided with round raised borders to prevent displacement when inserted between the molars on one side with the apex of the V backwards. The open end is joined by a vertical bar, to which a ring is attached and bent so as to be parallel to the portion in the mouth and serving as a handle outside the cheek. A block of hardwood between the teeth with a metal clip attached, fitting close to the cheek on the outside, answers the same purpose and is more suitable for the young horse, as he offers less resistance to it than to the metal instrument.

Similar instruments can be used for the other animals. In small dogs and cats a piece of tape applied round each jaw behind the canine teeth and pulled in opposite directions answers the purpose admirably and is often preferable to the speculum. A piece of wood placed transversely in the mouth between the molar teeth, pressing back the commissures of the lips, and fixed by a string from either end behind the ears, is useful for a refractory subject provided that it is not in the way of operative procedure.

The oral cavity can be illuminated by the aid of a mirror and artificial or natural light. An electric torch is very suitable for the purpose.

The molar teeth and alveolar borders of both jaws can be explored on their outer aspect by drawing the cheek outwards at the labial commissures by means of the finger or a smooth blunt instrument, even when the jaws are closed by a tape muzzle.

Affections of the Lips and Cheeks.—Open wounds of the lips and cheek are common in the horse and are caused by bites, nails, or sharp hooks, against which the animal strikes the muzzle, by falls, and by kicks from other horses. The commissures of the lips may be excoriated by the pressure of the bit. Despite the mobility of the part, the soiling of the wounds by alimentary matter and their contamination by the organisms of the mouth, they cicatrize rapidly, on account of the great vascularity of the region. They are similar in most respects to those of the nostrils and are dealt with on the same plan.

Perforating wounds of the cheek require deep sutures right through its substance in addition to cutaneous sutures.

When the lesions have been in existence for some time they require to be freshened to permit of healing by first intention.

The most difficult cases to deal with successfully are those involving section of the commissures and those perforating the cheek, with loss of tissue, causing an oral fistula of considerable size. Mobility militates against healing in the former case and the discharge of alimentary matter and saliva associated with the gaping of the orifice are obstacles to it in the latter case. The indications are to overcome these difficulties by appropriate measures. After dressing, suturing, and sealing the wound give liquid diet only for a few days, fix the jaws with a nose-band when the animal is not feeding, and tie him on the pillar-reins as described in connection with wounds of the nostrils. If the loss of tissue prevents intimate approximation of the lips of the fistulous wound an autoplastic operation may be performed as follows :

Make a horizontal incision (head being horizontal) at a tangent to the wound above and below extending a short distance to either side of it, mapping out rectangular flaps of skin, separated by the original wound. Mobilize each flap by dissecting it from the subcutaneous tissue, freshen the borders of the fistula, unite all the opposing edges with interrupted sutures, seal the wound with collodion and iodoform, and take the steps mentioned to favour the healing process. Loss of substance in the labial borders will prevent the horse drinking by suction in the ordinary way, and will necessitate his immersing his muzzle below the level of the commissures. If there be much loss of tissue their function as prehensible organs may be interfered with. Small loss of substance may be remedied by Syme's autoplastic operation for the same condition in man thus :

Prolong the two borders of the wound upwards to form a V-shaped incision, *d b e* (Fig. 191, *a*). From the extremity of each branch of the V make another short incision to enable the skin to be drawn down afterwards to bring the edges *d b* and *e b* into apposition. Mobilize the skin between the incisions and the borders of the wound by dissecting it from the underlying tissue, and suture the edges *d b* and *b e*. The two little triangular areas above the sutured wound will heal by granulations (Fig. 191, *b*). Freshen the border *a b c*, and bring the mucous membrane and skin together with sutures. In the case of the dog protect the wound by a muzzle until it heals, to prevent the animal rubbing or scratching it.

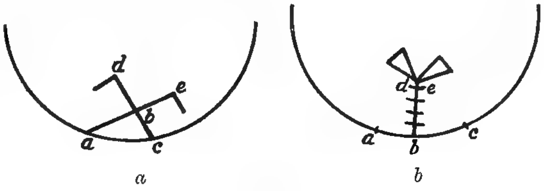

FIG. 191.

When Stenson's Duct is opened it is advisable, but not always essential, to perforate the cheek at the level of the wound before suturing the latter to allow the saliva to flow freely into the mouth instead of coming outwards and interfering with the healing process.

Hare-lip (Congenital Fissure of the Upper Lip).—This may be uni- or bilateral and extend a variable distance into the lip. It may exist alone or be accompanied by cleft palate.

Treatment.—Remove a thin slice of tissue from each border of the fissure and bring them into contact by deep sutures, not going through the mucous membrane. The pin suture is suitable. Apply collodion and orthoform to seal the wound.

The lower lip may be affected in a similar way, and the condition may be associated with a bifid inferior maxilla. If confined to the lip operation will prove successful.

Retraction of the Lip.—Sometimes as the result of injury and the consequent development of much fibrous tissue between the lip and the gum, cicatricial contraction retracts the lip and prevents its meeting the other one. This may be remedied by making an incision between the gum and the lip so as to mobilize the latter and allow it to come down or up, as the case may be. Or some of the new tissue may be removed by making two parallel incisions transversely between the lip and jaw and excising the intervening portion. The condition is apt to recur owing to the formation of more scar-tissue.

Dermatitis of the Lips in Lambs.—A vegetative dermatitis has been seen affecting the borders of the lips in lambs, due, in the opinion of Megnin, to sarcosporidia. It is a contagious affection beginning in the form of excoriation on which granulations or vegetations afterwards develop. Excision of the vegetations and the application of a mild antiseptic (boracic acid, potass. permanganate) lotion effect a cure. It may be necessary to apply lunar caustic after the use of the knife or scissors when the wound granulates excessively. Take the usual precautions to prevent the contagium spreading.

Ulceration of the Lip in the Cat.—Occasionally in the cat one meets with a case of ulceration of the upper lip which gradually extends until a considerable portion of the organ is destroyed, exposing the teeth and gums. It commences at its free border either in the centre or to one side of the middle line. It may eventually become arrested and be followed by cure or it may remain progressive, causing pain and toxæmia followed by emaciation and death. The lesion may be tuberculous, and a microscopic examination for the tubercle bacillus should be made. If not due to this cause bathe it with antiseptic lotion two or three times daily and paint it with tincture of iodine or an aqueous solution of methylene blue. Isolate the patient and feed it generously, giving it a good allowance of meat.

Tumours.—Papillomata or warts are common on the lips of the horse and are less frequently seen on those of the ox. They have been dealt with in Tumours on the Nostrils.

Multiple papillomata are often found on the buccal mucous membrane and gums in the dog, and appear to be of a contagious nature, as all the animals in a kennel may become affected one after another.

Symptoms.—The tumours form in clusters and are of various dimensions. They cause salivation and usually an offensive smell from the mouth.

Prognosis.—The warts may disappear spontaneously. They respond readily to treatment.

Treatment.—Excise the large warts and apply an astringent mouth-wash to the remainder (solution of alum, potass. chlorate), or paint them with a slight irritant solution (dilute solution of acetic acid or ammonia). Administer saline laxative medicine internally such as magnesia or soda bicarb.

Malignant tumours are not common as primary growths on the lips of the large animals, but epithelioma frequently develops on the lips of the dog. It commences as a small, hard swelling which soon ulcerates and rapidly extends in area and depth, involving the bone. Its surface becomes red and angry and presents a mulberry-like appearance. The neighbouring lymphatic glands are easily affected. There is an offensive odour from the mouth, due to the decomposition of food which adheres to the diseased surface and to the discharge which comes from the latter.

Treatment.—When the disease is well established it is futile to interfere, as the tumour cannot then be eradicated. When it is small and confined to the lip it may be excised by a V-shaped incision, the base of the V corresponding to the free border of the lip, the resulting wound being deeply sutured, the stitches going right through the lip except the mucous membrane. If necessary, Syme's autoplastic operation may be performed. (See " Wounds of Lips.")

Cysts.—A mucoid retention cyst, due apparently to obstruction of the duct of a mucous gland, sometimes forms on the inner aspect of the lips. When opened a clear viscid fluid escapes. The treatment consists in removing a portion of its wall and destroying its lining by the application of an irritant such as tincture of iodine, or in complete extirpation of the cyst.

Paralysis of the Facial Nerve.—Paralysis of the facial nerve is not a rare condition in the horse. It may be uni- or bilateral, and its origin may be peripheral, intra-temporal, medullary, or cerebral.

Peripheral Paralysis.—*Etiology.*—The cause may be :

(1) *Traumatic*, a contusion or wound involving the nerve where it turns round the inferior maxilla below the temporo-maxillary articulation. (2) *Toxic*, occurring during the course of an infectious disease like influenza or strangles. (3) *Physical*, from exposure to severe cold, a rare occurrence. (4) *A tumour* in the parotid region pressing on the nerve. (5) *Inflammation* in the duct of Fallopius causing pressure on the nerve.

Symptoms.—In unilateral paralysis the lips are drawn towards the sound side. When it is bilateral they are pendulous and incapable of prehension ; the animal is unable to drink without immersing its muzzle above the level of the commissures ; the nostrils are contracted ; and the respiration, which is normal at rest, is noisy during movement. When the nerve is injured behind the origin of the anterior auricular branch there is paralysis of the orbicular sphincter muscle and the patient is unable to close its eyelids. If the lesion be intratemporal there is paralysis of the ear of the affected side, the tongue may be involved, some deafness may be present, and there may be slight dysphagia. When the medulla is the seat of the cause the limbs of the opposite side of the body may also be paralysed. When the origin of the condition is in the cerebrum there is usually paralysis of the limbs of the same side of the body.

Treatment.—The treatment is that for paralysis in general. The first indication is to ascertain the cause of the condition and remove it if possible. Peripheral paralysis is usually followed by recovery in the course of five or six weeks. Persistence of faradic irritability is a sign of early cure.

When the affection is the result of contusion treat the latter. If there be a tumour pressing on the nerve remove it if practicable. When the lesion appears to be in the brain prescribe potassium iodide. Electric therapy is also indicated, using a continuous current of feeble power for five or ten minutes daily.

Care must be taken to supply food to the horse in such a way that he can grasp it with his teeth when both sides of the face are paralysed.

To relieve dyspnœa during exercise the nostrils may be kept dilated by means of brass wire fixed to the brow-band of the bridle.

Traumatic Lesions.—The mouth may be wounded from without inwards by the penetration of sharp or pointed bodies entering through the cheek or jowl, by sharp molar or incisor teeth lacerating the cheeks and lips respectively, by fragments of bone in fracture of the jaw, by the bit affecting the bars, by foreign bodies taken in with the food such as nails, needles, pins, fish-hooks, etc., and by laymen lancing or burning the palate for lampas.

These wounds are only serious when important organs are involved or large vessels are ruptured.

Treatment.—Ordinary wounds of the mouth heal rapidly. It is only necessary to keep them clean by washing out the mouth with cold water after feeding. The cause should always be removed by extracting a foreign body if present, and by discontinuing the use of an offending bit. Soft or liquid diet should be given requiring little or no mastication. If necrosis of the inferior maxilla supervene from injury by the bit treat it as described in connection with affections of the jaws.

Hæmorrhage from the palato-labial artery is generally most conveniently arrested by the hot-iron. The vessel is most commonly wounded at the level of the line joining the corner incisor teeth where it turns inwards on either side to meet its fellow. In this situation the bleeding can be stopped by tying a cord tightly round the upper jaw and beneath the upper lip, and leaving it in position for a few hours, or a pad soaked in tinct. benz. co. may be applied over the wound and compressed by a cord as described, or by a bandage over the face. A suture is often sufficient to arrest fairly profuse hæmorrhage from a wound on the buccal aspect of the lips. Ligation may be performed on a bleeding vessel in the soft parts of the mouth if within reach.

Foreign Bodies in the Mouth.—Foreign bodies lodged in the mouth are most common in the ox and dog, but are found in all our animals. They may be a needle embedded in the tongue or cheek, a piece of wood fixed across the palate or floor of the mouth or between the teeth and the cheek, a fish-hook embedded in the dog's or cat's cheek, and a piece of bone fixed on the molar teeth in carnivora.

Cattle are very prone to pick up foreign bodies, especially when pregnant.

Symptoms.—The animal is unable to feed. Saliva trickles from the mouth, which may be half open ; the patient appears more or less distressed ; the dog rubs its paws against the jaws in an effort to dislodge the object, may hide in dark corners or beneath furniture and give the owner the impression that it is affected with rabies.

The cause of these symptoms is often overlooked by the person in charge, with the result that he treats it for something else, and when the veterinarian sees the case the patient is weak and more or less emaciated for want of food.

On careful examination of the mouth the foreign body is discovered, and there is usually an offensive odour from the cavity when the object is of considerable size, due to food material adhering to it. It is most noticeable in the dog.

Treatment.—Extract the foreign body with forceps or the hand. A needle generally has a piece of thread attached to it, and is usually inserted with the point forwards. Hence to remove it draw the thread backwards. Fish-hooks in the cheeks are usually most readily taken out by pushing them outwards through the skin, the barbs preventing their being drawn towards the mouth.

Scalds.—The mouth may be scalded by too hot drinks or mashes, or by caustic drugs or agents such as turpentine or ammonia in concentrated solution, or lime.

Symptoms.—The symptoms are those of stomatitis, tenderness in the mouth, salivation, inability to eat coarse food, or difficulty in doing so.

Treatment.—The case responds to expectant treatment, or to the use of astringent mouth-washes, alkaline solutions such as those of soda bicarb. or lime or magnesia being indicated when the condition is due to an acid, and acidulated solutions of vinegar or tartaric acid being required when the lesion is caused by an alkali. Antiseptic lotion (cresyl 1 in 100 or thymol 1 in 1000 or potass. permanganate 1 in 1000) should be used afterwards to prevent the propagation of organisms.

Sloppy diet is indicated until recovery supervenes.

Affections of the Tongue. Wounds.—The tongue is frequently wounded in various ways, for example, by needles, bits of glass or flint taken in with the food, by sharp teeth, by excessive traction on the organ when manipulating it in administering a bolus to a horse, by a cord tied round the lower jaw including the tongue, or by being bitten during anæsthesia.

The nature of the wound varies in different cases. It may be superficial or deep, affect the frænum or the tongue proper, or involve section of more or less of the thickness of the organ or loss of a portion of it.

Hæmorrhage is usually slight.

Although practically the whole of the free portion of the organ is lost by section or by gangrene, recovery usually takes place. If severed above the frænum its function in assisting in mastication by keeping the food between the teeth is destroyed and the herbivorous animal succumbs to inanition. Loss of the anterior part of the tongue prevents the dog lapping, but after a while it acquires the power of drinking by suction.

Treatment.—In most cases simple washing out of the mouth with a suitable lotion, as mentioned before, is sufficient.

If the hyoglossal artery is cut it can be ligatured after casting the horse, if necessary. When the organ is partially severed it should be sutured by strong silk going right through its thickness.

Even if only held by a thin band of tissue the semi-detached and main portions may unite by first intention when they are kept in intimate contact by sutures.

Primary healing sometimes occurs after the wound has been in existence for some days, when its surfaces are freshened and sutured. A portion of one side of the organ may be destroyed and be followed by recovery without any loss of function. When the free portion of the tongue is lost in the horse or ox mastication is difficult for a while but eventually becomes normal except that the process is slower, the animal taking longer to finish its feed.

Cutting the frænum renders the stump more mobile and thus more adaptable for performing the function required of it.

Strangulation of the free portion of the tongue has been caused in the horse by tying a string round it as a means of control when the animal is vicious or by including it in a cord fixed and left round the lower jaw. The organ becomes swollen and cyanotic from venous engorgement in front of the ligature and remains normal behind it. If relief is not forthcoming within about twenty-four hours the distal portion will undergo necrosis from arrest of the blood supply. The treatment is to remove the ligature and scarify the swelling on the dorsum of the organ to prevent pressure necrosis by the engorgement even after the ligature has been removed. There is no danger of wounding the artery as it is deeply situated.

Venous hæmorrhage resulting from this procedure or other causes may be arrested by applying a thick layer of flour on the dorsum linguæ as advised by Moller and keeping the jaws strapped together by a tight nose-band.

Strangulation of the tongue in the dog may be caused by a rubber ring being slipped over it or by a section of a large blood-vessel, such as the aorta of the ox, becoming fixed round it, or it may be a portion of the trachea which causes this accident.

Tumours.—Tumours of the tongue are exceedingly rare in veterinary practice.

Mucoid, serous, dermoid, and glandular cysts have been found on the base of the organ, chiefly in the horse.

When of considerable size they interfere with mastication and deglutition and may cause dyspnœa or even asphyxia.

The treatment is the usual one for a cyst, incision or partial excision and destruction of the lining of the cyst. Owing to difficulty in reaching it, complete removal is generally impossible. The hot-iron has been used successfully to cauterize the interior of the cyst after puncture and iodine injections had failed.

Neoplasms, including fibromata, lipomata, and angiomata, are recorded as affecting the tongue, in rare instances.

Carcinoma, confined to the tongue, is practically unknown in the domesticated animals. Epithelioma affecting the fauces usually involves the tongue.

Symptoms.—Tumours cause difficulty in mastication characterized by the usual signs of trouble in the mouth, salivation, quidding, that is, partially chewing the food and allowing it to drop from the mouth soaked with saliva. Deglutition is also interfered with.

Treatment.—Malignant tumours should not be interfered with except they are confined to the anterior portion of the organ, when prompt amputation of the whole of the free part of the tongue should be performed, using the knife for the purpose, arresting the hæmorrhage by ligation of the vessels, and treating the wound afterwards as already indicated.

Ranula.—Ranula is a cystic swelling which sometimes forms at the side of the frænum linguæ, due apparently to obstruction of a mucous gland or one of the ducts of the sublingual salivary gland. It has been seen in all veterinary patients, but is most frequently encountered in the dog. It interferes with mastication and swallowing, but is not inflammatory.

Its size seldom exceeds that of a hen's egg.

Treatment.—Open it largely or remove a portion of it and paint its interior with tincture of iodine to cause inflammation, granulation, and cicatrization. Other agents which may be employed are chloride of zinc (10 in 100) or silver nitrate (10 to 20 per cent, or the pure stick). The caustic should not be allowed to touch the mucous membrane. Excess of the agent should be mopped up with a little cotton-wool moistened with boiled water.

A cyst of a similar nature and origin but larger, as a rule, appears externally on the under aspect of the throat, in the dog causing a remarkably large, pendulous, painless swelling in this region.

Treat it in the same way as the cyst in the mouth.

Paralysis. Glossoplegia. — Paralysis of the tongue may be peripheral or central in origin, usually the latter when it is the result of meningitis or hydrocephalus or some other lesion of the brain.

It is the first symptom of labio-glosso-laryngeal paralysis. It may occur during the course of an infectious disease, such as influenza, distemper, contagious pleuro-pneumonia, and rabies. It may be of traumatic origin, resulting from a wound or excessive traction of the organ.

Symptoms.—In a case of unilateral paralysis (monoplegia) the tongue is deviated towards the non-affected side.

When diplegia is present the organ hangs inert, protruding more or less from the mouth. When monoplegia has been in existence for some time the affected side of the tongue atrophies to such a degree that its dorsal and ventral mucous membranes come into contact.

Prognosis.—Occurring during an infectious disease the condition is usually temporary, disappearing in the course of seven to ten days. The same may be the case when it is due to traumatism provided that the nerve is not severed. In monoplegia the tongue is able to perform its functions, but in diplegia it is functionless.

Treatment.—Treat as for paralysis in general. Nux vomica and potassium iodide are always indicated internally. If improvement does not occur within a reasonable time in a case of diplegia there is no chance of recovery and the animal may be destroyed.

Affections of the Palate. Fissure.—Congenital fissure of the soft palate has been seen in the foal, and the same condition of the hard palate has been recorded in the horse, ox, and dog, usually accompanied by other anomalies constituting a monstrosity, but sometimes existing alone.

Fissures of the soft palate interfere with swallowing, and some of the milk or food material is returned by the nasal passages. The affected animal gradually wastes and, if not relieved, dies.

Treatment is not often undertaken in veterinary practice, but it is possible to perform one of the following operations :

1. *Staphylorrhaphy.* — Suturing the edges of the fissure ; very difficult to perform in the large animals owing to the depth of the mouth.

Anæsthetize the patient, fix him in the dorsal position with the head and neck extended. Have the mouth widely opened by a speculum. Freshen the edges of the fissure by means of long scissors or a bistoury, and unite them by interrupted silver wire sutures.

If it be impossible to keep the edges of the cleft in contact owing to their being far apart, make an incision on either side of and parallel to the fissure of sufficient extent to relieve the tension on the sutures.

2. *Uranoplasty.*—Make a longitudinal incision on either side of the hard palate, hugging the bone to avoid the palatine artery. Separate the mucous membrane and its fibrous foundation from the palatine bone between the fissure and the incision and then proceed as in the last case.

Affections of the Teeth.—The affections of the teeth may be classified as follows :

1. Abnormalities of development.
2. Irregularities in the wear of the teeth.
3. Alterations in the substance of the teeth.
4. Affections of the alveolar periosteum.

1. **Abnormalities of development** comprise :

(*a*) Abnormality in the number of the teeth.

(*b*) Irregularities in the shedding of the temporary teeth.

(*c*) Anomalies in the position and direction of the teeth.

(*a*) **Abnormalities in the Number of the Teeth.**—Supplementary incisor, canine, and molar teeth are fairly often met with. A double row of incisor teeth in the horse is occasionally seen. The supernumerary incisors always belong to the permanent dentition. Additional canine teeth are rarely encountered, but increase in the number of molars is fairly common, the extra teeth being usually situated in the upper jaw in a line with the normal teeth or inside or outside the latter.

Diminution in the number of the teeth is less common but occasionally occurs.

(*b*) **Irregularities in the Shedding of the Teeth.**—Sometimes the milk-teeth persist for an abnormal length of time, with the result that the permanent teeth take an abnormal course.

This most commonly occurs in connection with the incisors, the permanent appearing behind the temporary teeth.

(*c*) **Abnormalities in the Position and Direction of the Teeth.**—Not infrequently the incisor teeth develop in abnormal positions, overlapping or assuming a transverse or an oblique direction, or being partially or completely rotated on their long axis.

Inequality in the length of the jaws prevents the upper and lower incisors coming into accurate contact.

The teeth consequently become excessively long for want of wear, and those of the shorter jaw may penetrate the soft tissues opposite. When the upper jaw is the longer the condition is called "parrot mouth," and when the lower one is the longer it is called pig or "sow mouth."

The teeth sometimes, instead of being arranged in close contact, have spaces between them in which food material lodges, causing inflammation of the gums and interfering with mastication. Some of the alimentary matter may become insinuated between the gum and the fang, leading to alveolar periostitis.

Symptoms.—Many of the foregoing abnormalities may exist for a long time without causing any trouble or attracting attention, but there may be interference with mastication or prehension.

In the case of a pronounced "parrot" or sow mouth the horse has great difficulty in grazing, as the incisor teeth do not meet properly to cut the grass. A tooth abnormally situated and wounding the sensitive tissues such as the tongue, palate, jaws, cheeks, or lips causes pain, and consequently prevents normal mastication.

Spaces between the teeth have the effects mentioned. Just before separation of the temporary teeth, when they are in the form of shells, food material may penetrate beneath them, irritating the gums and causing symptoms of trouble in the mouth. The affected gum becomes inflamed and red, and there may be salivation and difficulty in feeding.

Treatment.—The treatment consists in removing the cause of the trouble, shortening or extracting abnormally-situated teeth which have no opponents to keep them in wear and consequently continue to increase in length and damage the soft tissues with which they come in contact. When the temporary teeth are a source of trouble just before eruption of the permanent successors, or persist along with the latter, causing an interspace for the accumulation of alimentary matter, they should be removed.

2. **Irregularities of Wear.**—Irregularities of the molar teeth, due to unequal wear of the different teeth, or of parts of individual teeth, are very common in the horse.

The various irregularities may be classified as follows :

I. **Sharp Teeth.**—The outer border of the upper molar and the inner border of the lower ones become sharp.

The factors which account for this condition are : (*a*) the upper jaw being wider than the lower one, and the movement of mastication being from side to side causing the inner aspect of the tables of the upper teeth and the outer aspect of those of the inferior teeth to undergo most wear. (*b*) Restricted lateral movement of the jaws from any cause, such as debility of the masseter muscles, inflammatory conditions of the cheeks, gums, or tongue, and giving food requiring little mastication, for example, bruised instead of whole corn. (*c*) The tables of the upper and lower molars being normally slightly inclined downwards and outwards (the head being horizontal).

When this irregularity is well marked it acts itself as a cause as well as an effect by causing overlapping of the upper and lower rows of teeth, and thus limiting lateral movement of the jaws.

Symptoms.—The symptoms comprise :

(1) *Interference with mastication* due to the sharp edges causing pain by lacerating the tongue and cheeks during movement of the jaws. It is manifested by: (*a*) "Quidding" hard food like oats and hay, that is, partially chewing it and letting it drop out of the mouth saturated with saliva. (*b*) *Salivation*, characterized by foaming at the mouth, and by the escape of saliva therefrom during feeding, the manger and the food being moistened by the fluid. (*c*) *Imperfect grinding*, recognized by the absence of the normal grinding sound during mastication, and by cautious, limited movement of the jaws. (*d*) Holding the head to one side when chewing. (*e*) *Food collecting between the teeth and the cheek* in the intervals between feeding.

(2) *The presence of the sharp borders on the teeth* detected on manual examination.

(3) *Wounds of the cheeks or tongue, or both,* due to laceration by the sharp edges.

(4) *Loss of condition*, due to indigestion and defective nutrition following imperfect mastication.

There are degrees and varieties of the condition, the foregoing symptoms being those of a typical case.

Treatment.—Remove the sharp borders of the teeth by means of the tooth-rasp or float. Have the horse backed into a corner, securely held by a halter with the nose-band slack. Have the tongue taken out at the opposite side of the mouth and apply the rasp to the outer edge of the upper and to the inner edge of the lower molars. Having filed all the teeth, pass the hand into the mouth with or without the aid of the oral speculum, and feel the teeth to ascertain if all the sharpness has been removed.

II. **Overlapping Molars.**—The upper and lower molars overlap each other like the blades of a shears. The condition is an aggravated form of sharp teeth and is brought about in the same way. It occurs in old horses. The upper molars may be so long that they wound the gum of the lower jaw next the cheek, and the lower ones may reach to and injure the palate. As a rule, little can be done in the way of remedy. Repeated use of the rasp may have some effect. When there are projections here and there they can be cut with the tooth-shears before using the rasp.

III. **Irregularities affecting Single Teeth.**—Frequently the first superior molar overhangs the corresponding lower molar in front, and the last inferior molar projects behind the last superior molar, so that a hook or projection forms on each of these teeth due to their entire table surfaces not undergoing wear. The projecting portion may be so sharp that it wounds the tongue or cheek. The remedy for this condition is to remove the projection with a tooth-shears or tooth-chisel. Holding the end of a flat bar of iron against the abnormal portion of the tooth and striking it with a hammer or mallet will break it off. It is often difficult to apply the shears at the anterior or posterior extremity of the dental arch. Any remaining sharp edge is removed with the rasp.

These single irregularities are not confined to the terminal teeth of the rows. Occasionally one of those towards the centre of the row is affected.

IV. **Undulating Molar Tables.**—In this condition the lower row of molars is concave, and the upper row is convex in its centre. Otherwise the teeth are normal. This abnormal configuration is only serious when the fourth inferior molar, which is usually the lowest tooth of the row, becomes worn below the level of the gum, allowing the entrance into the alveolus of alimentary matter and infection which set up alveolar periostitis. The corresponding superior tooth, which is the longest of its row, may then wound the gum opposite. Nothing can be done to improve the condition except to treat alveolar periostitis if it supervenes as a complication, and shorten or extract the offending upper molar.

V. **Step-formed Tables.**—Here neighbouring teeth are of unequal height, being up and down like steps of a stairs. This condition interferes more or less with mastication.

Treatment.—Cut the long teeth with the tooth-shears, and smooth the cut surfaces with the rasp.

When the condition is due to the absence of an opposing tooth the overgrown one must be shortened periodically, not being subjected to wear.

VI. **Smooth Teeth.**—The tables of the molar teeth are smooth like the keys of a piano, and are useless for grinding.

The smoothness is due to equal wearing of the enamel and dentine of the teeth, and, in very old horses, to the crowns being completely worn away. If only a few teeth are involved the abnormality is of little or no consequence, but if the majority of the teeth are affected the patient's health suffers through indigestion from imperfect mastication.

3. **Alterations in the Substance of the Teeth. Fractures.**—Fractures of teeth are fairly common in the horse, especially of the incisor teeth, and they result from direct violence usually caused by falls.

The teeth may be broken right across, or fissured, or splintered, and the fracture may involve the crown only or extend to the fang and open the pulp cavity, exposing it to infection which sets up alveolar periostitis. In the molar teeth the fissure or fracture is usually caused by some hard substance in the food, a nail or a bit of flint which the animal unexpectedly chews.

Difficult mastication may result from wounding of the soft tissues by the sharp teeth.

The accident may not be noticed in the case of the molars until alveolar periostitis supervenes.

Treatment.—If the fracture be partial, involving only a portion of the crown, smooth the rough surface left with the rasp. If the fang is affected the tooth must be extracted.

Dental Tartar.—Dental tartar is a greyish-yellow deposit on the teeth formed from the fluids of the mouth and composed of carbonate and phosphate of lime, magnesium carbonate, and organic matter, comprising bacteria and mucus.

Etiology.—The condition is very common in old pampered house dogs, receiving little exercise and getting food that requires no tearing or gnawing which tends to keep the teeth clean.

It is rare in herbivora and when present is of no consequence. It is less frequently met with in the cat than in the dog.

Symptoms in the Dog.—In the early stages of the affection the only symptom is the appearance of the deposit on the teeth. It forms on the incisors, canines, and molars, mostly at the base of the teeth and on their outer aspect. After a while it tends to encroach on the fangs, causing inflammation of the gum and separating it from the teeth, thus opening the alveoli and allowing alimentary matter with organisms to gain entrance thereto and set up alveolar periostitis, which is usually present, affecting one or more teeth, when the patient is brought for treatment.

In a well-established case the following symptoms are observed :

(1) *Salivation*, the saliva escaping from the mouth, especially during feeding. (2) *An offensive odour from the mouth*, which is very pronounced. (3) *Difficulty in eating hard food*, which hurts the inflamed gums, the animal whining when attempting to gnaw a bone. (4) *Inflammation and redness of the gums*, which are very tender and bleed easily on being touched. They may be ulcerated. (5) *Looseness of some of the teeth* due to alveolar periostitis. (6) *The presence of the tartar*, which is usually found on the majority if not all of the teeth. (7) *Resentment of the patient to handling of the mouth*, which causes pain and makes the animal cry. Similar symptoms occur in the cat.

Prevention consists in keeping dogs under more natural conditions, restricting their diet, giving them plenty of exercise, allowing them to gnaw bones or crusts of bread with a view to keeping the teeth clean, examining the mouth occasionally, and if the teeth show a deposit, scraping it off and brushing them with chalk or some dentrifice.

Treatment.—The procedure may be as follows :

(1) Have the dog well controlled, with a tape muzzle applied if necessary. The latter will allow access to most of the teeth for the removal of the tartar.

(2) Scrape off the tartar by means of scalers for the purpose or by one of the limbs of an ordinary dissecting forceps, applying the force from the gum towards the table of the tooth.

(3) The teeth may be brushed with powdered chalk or pumice-stone to remove all trace of the tartar.

(4) Wash out the mouth with a solution of alum (2 in 100), or potass. permanganate (1 in 1000), or thymol (1 in 1000), etc., and if the gums are ulcerated paint the ulcers with tincture of iodine.

(5) Remove loose teeth.

Caries.—Caries of the teeth is rare in animals but less so in herbivora than in carnivora, and is practically confined to the molars. It may be defined as a molecular destruction of the cement and dentine of the tooth, the enamel being, comparatively speaking, intact.

The disease is apparently due to bacteria, and is favoured by food lodging and decomposing in spaces between the teeth or in depressions on the tables of the latter. Ordinarily the enamel on the tooth becomes more or less filled with a cement substance, but occasionally it is absent and then a cavity exists in which alimentary debris collects and may have the effect mentioned. Micro-organisms are said to have been found in the dentine tubules.

The disease may extend into the pulp cavity and give rise to alveolar periostitis.

Symptoms.—The condition may be long in existence before being detected.

It is only when mastication is interfered with that attention is drawn to the affection by the usual symptoms of trouble in the mouth already described (Irregularities of Wear), and by an offensive odour from the cavity. On examination of the mouth the lesion is discovered as a black spot on the tooth in the early stage of the disease, and as a cavity therein when it is more advanced. The decomposed food material in the hollow of the tooth has a very fœtid odour which is communicated to the finger after digital examination of the diseased part. The tooth may have fractured or the caries may be complicated by disease of the dental alveolus when the case is brought for treatment.

Treatment.—If the case is seen early, before the tooth is deeply excavated, curetting the diseased spot, disinfecting it, and shaping it to enable filling to be retained, and stopping the cavity with cement or amalgam may preserve the tooth. As a rule, the case is too far gone to allow this to be done successfully and the tooth must then be removed.

4. **Affections of the Alveolar Periosteum. Alveolar Periostitis.**—Alveolar periostitis or peri-odontitis, inflammation of the periosteum lining the dental alveolus, is probably the most common disease of the teeth in our animals.

Etiology.—Anything which causes injury and infection of the alveolar periosteum acts as a cause of the condition, such as: (1) *Alimentary matter insinuating itself between the gum and the tooth*, opening the alveolus and allowing foreign matter and bacteria to enter it. (2) *Fissures or caries* of the tooth extending into the pulp cavity. (3) *A tumour on the jaw* causing separation of the gum from the tooth. (4) *A compound fracture* of the jaw involving the alveolus. (5) *Tartar on the teeth* in the dog, the chief cause of it in this animal and in the cat, but rarely acting as such in the large animals.

Symptoms.—The gum in the affected region is red, swollen, painful to the touch and receding from the tooth, which is more or less loose. The bone in the vicinity may become affected with purulent osteomyelitis, causing a large inflammatory swelling on the jaw at the level of the affected tooth. When the disease is in connection with the posterior upper molars it usually gives rise to pus in the sinuses, and when the anterior molars above are involved there may be perforation of the floor of the nasal cavity. When an abscess bursts on the surface of the jaw a dental fistula develops there.

In a chronic case of alveolar periostitis an odontoma may form on the root of the tooth.

Treatment.—Once the disease is established the tooth must be removed. Complications, *e.g.* pus in the sinus and dental fistula, are treated according to their nature.

After extraction of the affected tooth or teeth, prescribe a mouth-wash to be used until healing takes place.

Dental Fistula.—A dental fistula is a suppurating tract abutting on the fang of a tooth and opening on the surface of the jaw or into the maxillary sinus or nasal cavity.

It is a common condition in the horse and is also frequently met with in the dog, but is rare in other animals.

Etiology.—The cause of the condition may be: (1) *Alveolar periostitis*, the bone in the vicinity becoming affected with necrosis and suppuration extending until the skin ulcerates or the cavity of the nose or sinus is perforated. (2) *External injury and infection* causing necrosis of the bone and involving the alveolus of a tooth. Occurring in this way it is most commonly situated on the posterior border of the lower jaw at the level of the first or second molar, where it is caused by striking the jaw against the manger or some fixed object.

In the dog the condition is due to ulceration of one or more of the fangs of the upper carnassial tooth (fourth molar), which causes the accumulation of pus in the antrum. The pus causes destruction of the overlying bone and escapes by bringing about ulceration and perforation of the skin a little below the lower eyelid towards the nasal canthus.

Symptoms.—The fistula is easily recognized when it opens on the face, where it appears as a weeping orifice surrounded by a variable degree of inflammatory swelling of the bone, which is more or less tender to the touch. A probe passed into the fistula may encounter loose pieces of bone and comes into contact with the root of the tooth, and if there be an oral orifice, which is frequently the case, the instrument can be passed into the mouth.

When alveolar periostitis is absent there may be no hindrance to mastication, and nothing abnormal may be noticed on examination of the mouth.

There may, however, be some redness of the gum at the level of the tooth whose fang is involved, and if an oral fistula be present its opening may be seen. When periodontitis is present its symptoms are manifested as described. When the fistula communicates with the sinus or nasal cavity there is a unilateral, fœtid, purulent nasal discharge.

Treatment.—Dental fistula is treated by extraction of the affected tooth, which is acting as a septic foreign body. When due to injury, dental fistula is dealt with as described on p. 806, extraction of the tooth not being necessary as there is no diffuse inflammation of the alveolar periosteum.

Tumours.—Dental tumours comprise: (1) Cysts; and (2) solid tumours.

1. **Cysts** may develop along with the teeth or form after the development of the latter. They have been considered in connection with affections of the cranium and of the jaws.

2. **Solid tumours** are of two varieties, viz.: (*a*) **odontomata,** having the same histological structure as tooth; and (*b*) **pseudo-odontomata** exostoses, caused by injury of the fang of a tooth or a slight but chronic alveolar periostitis.

Symptoms.—Sometimes these solid tumours cause no symptoms, but usually they interfere with mastication, and consequently with digestion, and produce loss of condition and vigour. There is a swelling on the jaw at the level of the affected tooth.

On examination of the mouth the gum may be found swollen and tender in the vicinity of the tooth involved. It is usually the superior molars that are affected. There may be a discharge from the corresponding nostril.

Treatment.—Extract the affected tooth. Operation is generally very difficult and frequently involves fracture of the wall of the alveolus. It may be impossible to remove the tooth with the forceps, repulsion being necessary. Although partial fracture of the jaw may occur during the procedure by either method of removal, the cavity in the jaw usually heals without complications.

Several cases of successful treatment of the condition in the horse have been recorded.

It may be necessary after exposing a large tumour to fracture it with the chisel and mallet to remove it in sections and facilitate extraction or repulsion of the tooth to which it was attached.

Dental Operations.—Dental operations comprise:

(1) Filing of teeth; (2) section of teeth; (3) extraction of teeth; (4) repulsion of teeth.

1. **Filing of Teeth.**—*Indications.*—The operation is practically confined to the horse for the purpose of removing sharp edges or corners on the molar teeth and for shortening overgrown incisors.

Operations on the Molars. Control.—Have the horse backed into a corner or a stall with plenty of light in front and held with a slip or head-collar with the nose-band sufficiently slack to permit of the mouth being opened widely. A twitch on the upper lip or lower jaw or on the ear is seldom necessary. A mouth speculum is useful to keep the jaws apart during examination of the teeth, but is rather a disadvantage during the operation and may often have to be dispensed with altogether on account of its making the horse restive.

Instruments.—There are various patterns of tooth-rasps, including a small one which can be used with one hand, a very convenient instrument and especially suitable for young or small horses and for restive subjects; a larger one requiring the use of both hands; and a power rasp on the same principle as the power clipping machine, the rasp being spherical and working with a rotary movement. It is very useful for applying to a single tooth, but for general purposes the ordinary hand rasp is preferable. A pail of water is necessary to immerse the hand-file in occasionally to remove the filings from the grooves of the instrument.

Operation.—Let an assistant take the tongue out at the opposite side of the mouth with one hand and steady the head with the other hand placed on the face. Keeping the instrument under control to avoid wounding the gums or soft structures, apply it vigorously to the outer edge of the upper and the inner edge of the lower row of molars until the sharpness is removed.

Incisor Teeth.—In order to reduce overgrown incisors with the rasp it is necessary to have the horse cast and the jaws separated by a gag applied behind the teeth. The most suitable instrument for the purpose is a farrier's rasp, the file surface being employed.

2. **Section of Teeth.**—*Indications.*—Section is indicated for the removal of isolated prominences on the teeth and for shortening teeth that are too long.

Molar Teeth.—Control the horse as in No. 1. If the subject is restive, cast him or put him in stocks.

Instruments.—A speculum is necessary to keep the jaws separated during the operation. The instruments used for cutting the teeth or removing projections include:

(1) *The tooth-shears*, a powerful instrument made of steel whose handles are about two and a half feet in length. Power is brought to bear on its jaws by leverage through a series of joints as in "Squair's Tooth Shears," or by the handles being brought together by a screw as in Thompson's instrument. The former is an excellent forceps, but the latter is probably more convenient when great force is required, being less laborious to employ.

(2) *The Tooth-screw.*—This is in the form of a chisel whose blade is guarded by a frame to prevent injury to the sensitive tissues from slipping of the instrument. It is worked by the aid of a screw which is capable of exerting great pressure on the tooth. It is not much used, the forceps being a more suitable instrument.

(3) *The Tooth-chisel.*—In the form of an ordinary long cold-chisel, which is struck by a mallet after placing its edge against the part to be removed. Or a chisel guarded by a frame which surrounds the part to be cut may be used in the same way. The former is more generally useful as the frame of the latter often prevents the blade being applied at the most desirable point. The chisel should not have a keen edge. A farrier's rasp with one end placed against the tooth and the other struck by a mallet or hammer answers the purpose admirably in many cases. The chisel is necessary for projections which cannot be grasped by the shears.

(4) *The Tooth-plane.*—This is an instrument on the principle of a carpenter's plane, with a short, strong edge projecting beyond the level of the plane of the surface or frame on which it is fixed. It is useful for removing slight prominences before employing the rasp. It is not much in vogue.

Operation. Using the Shears.—Having the tongue held out of the mouth and the gag inserted, simply apply the shears in the required place, taking care to follow the movements of the animal with the instrument to avoid injury to the mouth from its displacement. When it is only a portion of a tooth that is to be cut it gives way quickly, but if a whole tooth is to be severed great force is required. When section occurs a report is heard due to the fracture of the structure. The separate portion must be removed from the mouth at once, if it does not drop out, to prevent its being swallowed or possibly falling into the larynx.

In an old horse the force required to cut an entire tooth sometimes causes it to separate from its alveolus and come away in the jaws of the shears.

When the projection on a tooth is very oblique the shears may fail to grasp it, and then the chisel or a piece of iron must be used to knock it off.

It is difficult to apply the shears at either extremity of the row of teeth, and here again the chisel proves more useful.

Using the Chisel.—The method of employing this has already been indicated. Great care must be taken lest by displacement it should wound the soft tissues.

Incisor Teeth.—Section of the incisor teeth is seldom performed. They are very apt to break irregularly when an attempt is made to cut them with a shears.

When they require to be shortened the farrier's file is the best instrument for the purpose.

3. **Extraction of Teeth.**—*Indications.*—Extraction of teeth is indicated in the following conditions: alveolar periostitis, caries, fracture involving the fangs of the teeth, odontomata

and pseudo-odontomata, dental fistula which fails to respond to other measures or is due to disease of the alveolus, and persisting temporary teeth causing masticatory trouble.

THE HORSE.—*Temporary Incisors.*—The temporary incisors, being mere shells just at the time of eruption of the permanent teeth, are easily removed by a human molar tooth forceps. They are often removed by horse-dealers at an earlier period to hasten the eruption of the permanent teeth and make the horse appear a year older than the true age. An awl is commonly employed by them to prise out the teeth.

Temporary Molars.—Control as for section of the teeth. The gag, which is applied between the upper and lower rows of molars on one side, is suitable for this operation, the one made of wood for preference. A fairly stout forceps, about fifteen inches long, with short corrugated jaws at right angles to its long axis is suitable. It can be used with one hand. The temporary crown is distinguished from the permanent one by the former having a worn surface with sharp borders and being shell-like on percussion; while the latter, not having undergone wear, has rounded borders and is solid on percussion. Having grasped the tooth with the forceps it is easily wrenched off.

Permanent Molars—Control.—If the tooth to be removed is not firmly fixed and the animal is quiet it can be extracted in the standing position, the horse being controlled as for preceding dental operations. Stocks are very convenient for the purpose. If the tooth is firmly embedded, especially in a young horse in which the fang is long, or if the subject be difficult to handle, it is better to cast and anæsthetize the patient, having him lying on his side with the head turned so as to rest on its poll, and having the light as far as possible shining into the mouth. A torch or mirror may be used to illuminate the oral cavity.

Instruments.—The forceps used for extracting the permanent molars requires to be a powerful instrument made of the best steel, its handles being about two feet long and half an inch in circumference. Its jaws are bent at right angles to the handle and are coarsely denticulated to grip the teeth, to which they are firmly fixed by means of a screw, which brings the handles together. The teeth being extracted from their sockets by leverage applied parallel to their long axis, and the fangs of the anterior molars being directed upwards and slightly forwards (the head being horizontal), and those of the posterior molars having the opposite direction, a lever of the first order would be required for the posterior teeth and one of the second order for the anterior ones. Hence a forceps with a prominent prolongation at the free extremity of its jaws to act as a fulcrum is suitable for the anterior molars, and one with a prominence on the joint of the instrument, for the same purpose, is convenient for the posterior molars. For the latter teeth a plate of wood or metal attached to a handle can be placed on the teeth immediately in front of the one grasped by the forceps to serve as a fulcrum, the instrument itself, in this case, not being provided with a fulcrum. Gunther has invented forceps answering the above requirements. The one for the anterior molars has its two branches jointed at one end like a compass, with its jaws a little distance from this extremity so that the latter serves as a fulcrum. The one for the posterior molars has its jaws at the extremity of the instrument and the joint at the base of the jaws. A separate instrument is used as a fulcrum in this case.

Operation.—Insert the oral speculum and have the tongue held out of the mouth as usual. Make sure of grasping the right tooth. If possible, place a finger on the tooth just beyond the one to be removed and introduce the forceps up to the finger. Have the mouth illuminated by natural or artificial light to enable you to see clearly what you are doing. The mistake of removing the wrong tooth has occurred often enough. Grasp the tooth as close to the fang as possible; fix the jaws of the forceps by turning the screw on the handles, avoiding great pressure if the tooth is hollow from caries for fear of crushing it; loosen the tooth by restricted side to side movements, tending to rotate the tooth on its long axis and by see-saw movements of the cross-bar on the handles. Having loosened the tooth, introduce the fulcrum beneath the forceps as near as possible to the jaws if a lever of the first order is being used, and prise out the tooth. If the fang be long it may be necessary to take a second grip with the forceps. In many cases in old subjects in which the fangs of the teeth are short they can be removed without the aid of a fulcrum, as they come away easily once they are made loose. One hand beneath the instrument is often sufficient as a *point d'appui*.

Having extracted the tooth, little after-treatment is required as a rule. The mouth should be washed out with a suitable lotion such as potassium permanganate solution, and this should be repeated after meals until the alveolus is nearly healed. If there be a large dental fistula opening on the skin, introduce a plug of gauze through the external orifice and keep the outer portion of the passage occluded until the lower portion is nearly obliterated by granulation tissue, the object being to prevent the escape of alimentary matter, which would delay the healing process. If there be pus or food material in the sinus, the latter must be evacuated and treated as described.

Permanent Incisors.—The permanent incisors rarely require extraction except they have become very loose as the result of an accident and there is no possibility of their becoming fixed again. They are then easily removed. A forceps of the same pattern as human dental forceps, but proportionately larger, answers the purpose.

THE DOG.—*Temporary Teeth.*—The temporary incisors and canines often persist after development of the permanent teeth, which are situated immediately behind them. They are a source of discomfort. Remove them with a small human tooth forceps, grasping the tooth as close as possible to the gum and using a cautious rotary movement to loosen the tooth without breaking it. When they do break at the level of the gum, no bad effects result from the embedded fangs.

Permanent Incisors or Molars.—When the permanent molars or incisors are affected with alveolar periostitis they are more or less loose and are very easily extracted. Apart from this disease the incisors rarely require removal. The fourth upper molar or carnassial tooth must be removed in a case of dental fistula due to pus in the antrum. For the operation, have the dog securely held or fixed in the ventral position on the table. Chloroform anæsthesia is seldom necessary, but if the animal offer great resistance a hypodermic injection of morphia may be used to keep the patient quiet. Have the mouth widely opened by means of a speculum or tapes on the upper and lower jaws. Grasp the tooth firmly above the crown with the molar tooth forceps, and with vigorous but restricted side to side and rotary movements loosen the tooth and then remove it by a strong pull parallel to the long axis of its fangs.

4. **Repulsion of Teeth.**—*Indications.*—Repulsion of teeth is indicated in cases where the teeth require to be removed and the forceps cannot be used for the purpose owing to the crowns being absent or being too small to afford a grip for the instrument, or because there are odontomata on their fangs preventing their withdrawal without fracture of the jaw.

THE HORSE.—*Molars. Control.*—Cast and anæsthetize the patient.

Site of Operation.—The site of operation is the level of the free extremity of the fang of the tooth to be removed.

Instruments.—The special instruments required for the operation are a trephine, a sharp chisel, a punch, and a mallet.

Operation.—Having accurately located and prepared the site, remove a disc-shaped piece of skin about one inch in diameter. If there are vessels or nerves in the way push them aside, cut through or push aside muscular tissue if present, and expose the bone. Trephine the latter over the centre of the dental fang. To make sure of trephining in the right place, insert the mouth speculum and pass a sharp-pointed, long-bladed bistoury through the cheek close to the alveolar border at the level of and parallel to the long axis of the affected tooth to serve as a guide. Operate on a line coinciding with the direction of the bistoury. A trocar might be used instead of the knife for this purpose.

Having exposed the extremity of the fang, enlarge the trephine opening by means of the chisel and mallet, taking care to direct the edge of the instrument towards the affected tooth to avoid wounding the neighbouring alveolus. When the fang has been uncovered in its entire width and for about half of its length, apply the punch at its free extremity and, holding it parallel to the long axis of the root of the tooth, strike it smartly and repeatedly, but not too forcibly, with the mallet so as to repel the tooth into the mouth, whence it must be instantly removed to prevent its being swallowed or falling into the larynx. Take care not to allow the punch to become displaced so as to penetrate between the tooth and the alveolar wall, causing fracture of the latter and exposure and infection of the adjoining alveolus.

Williams, of New York, recommends removal of the entire outer wall of the alveolus, which makes repulsion easier and prevents the formation of a fistula afterwards. He also advises fracturing the fang transversely and longitudinally by means of a heavy chisel and mallet, and removing it piecemeal in cases where repulsion of the intact tooth is very difficult. Greater care has to be exercised in repelling the inferior molars owing to the thinness of the lower jaw rendering it more liable to fracture. The punch in this case must be struck cautiously and lightly. Operation on the superior molars, with the exception of the first two, involves opening of the maxillary sinus.

After removal of the tooth, wash out the alveolus with a non-irritant, antiseptic lotion, and if the whole of the outer alveolar wall has not been removed plug the passage with antiseptic gauze. Renew the dressing daily until healing is almost accomplished.

Occasionally, especially when two contiguous teeth have been repelled, a fistula into the sinus persists and food material accumulates in the latter. The remedy for this condition is to open, evacuate, and wash out the sinus and fill the passage with gutta-percha. Soften the gutta-percha by immersion in hot water, and, with the fingers of one hand in the sinus and those of the other in the mouth, pack it in the passage, spreading it out slightly above and below to prevent it falling out. If the communication is with the nasal passage the same procedure is adopted. Several cases of successful treatment in this way have been recorded, including one by the author.

The gutta-percha may remain in position for years.

Dentition Fever.—Dental affections which impair mastication are responsible for constitutional disturbance, which is more or less pronounced according to the degree of interference with this important function.

The term " dentition fever " has been applied to the train of symptoms which sometimes appears during the eruption of the permanent teeth in the horse, due, apparently, to a variable degree of inflammation or tenderness of the gums caused by the irritation of the partially separated temporary teeth and the pressure of the developing permanent teeth.

It is usually between the ages of three and a half and four years that the condition is most frequently observed, this being the period during which the greatest number of teeth are being erupted, the following making their appearance about this time : the lateral incisors, the third and sixth permanent molars, and the canine teeth when present.

Symptoms.—The usual symptoms of masticatory trouble are observed, quidding, salivation, etc., and in addition those of indigestion and unthriftiness. Examination of the fæces in this as in other affections of dental origin shows that the food has been imperfectly chewed, that a large proportion of the grains of corn are passed intact. The animal is often affected with a cough, and the skin may be affected with papules, while the coat is dry and staring. The subject is comparatively weak and easily sweated if put to work.

Treatment.—Examine the mouth and remove partially separated teeth. Give food that is easily masticated ; a good allowance of bran mashes and steamed crushed oats or boiled barley. Prescribe some alkaline medicine to be given in the drinking-water, and an astringent mouth-wash to allay any inflammation that may exist.

Affections of the Eustachian Tubes. Wounds.—Wounds of the Eustachian tubes are rare except in conjunction with fracture of the base of the cranium, when they are of no practical importance, on account of the fatal nature of the latter.

Pathological conditions of neighbouring structures may involve the ducts. Their mucous lining being continuous with that of the pharynx and middle ear, inflammatory conditions affecting these organs are usually propagated to it.

Foreign Bodies in the Tubes.—Cases of particles of hay and grass and alimentary matter being lodged in the conduits have been recorded.

Obstruction of the Tubes.—The Eustachian tubes may become more or less obliterated as the result of inflammatory thickening, causing a variable degree of deafness owing to interference with the equilibrium of air pressure on both sides of the tympanum, the consequence being that the bones of the ear, pressed upon by the tympanic membrane which is displaced inwards, cause compression of the liquid in the labyrinth through the foramen ovale disturbing its function, and sometimes causing brain symptoms by irritation of the numerous nervous ramifications of the labyrinth communicating with the brain.

Tumours in the neighbouring parts may involve the tubes.

Positive diagnosis of the foregoing conditions is extremely difficult, and even if they are recognized little can be done for them except, where possible, to treat affections in their vicinity with which they may be associated.

Catarrh of and Collection of Pus in the Guttural Pouches.—*Etiology.*—The cause of catarrhal inflammation of one or both guttural pouches may be : (1) *Acute pharyngitis*, the inflammation spreading from the pharynx through the Eustachian tubes. In this way it may be a complication of strangles. (2) *Inflammation in the vicinity*, being propagated to the pouch by contiguity through the agency of bacteria, as may happen in a case of parotitis, or subparotid or post-pharyngeal abscess. (3) *Food material gaining entrance* to the pouch from the pharynx—a rare occurrence.

The inflammation assumes a chronic course and the exudate accumulates for want of a dependent orifice, the only means of escape being the Eustachian tube, whose upper opening is not at the lowest part of the cavity and consequently only acts as an outlet when the head is lowered or the walls of the pouch are compressed, as in the act of swallowing or mastication. There is therefore always a certain quantity of fluid present causing irritation and perpetuating the lesion. Much of the solid portion of the contents becomes inspissated and formed into chestnut-like bodies called chondroids, of which a large number may be present.

Symptoms.—The symptoms of pus in the guttural pouches are :

(1) *An intermittent nasal discharge*, which may be uni- or bilateral. Although only one pouch may be affected, the discharge may be from both nostrils. It appears during feeding ; when the head is lowered ; during exercise ; and sometimes when the pouch is compressed externally. It is inodorous as a rule, muco-purulent in character, contains yellowish-white flocculi of variable size, and does not adhere to or become inspissated on the nostrils. In rare cases it is blood-stained. due to ulceration of the lining of the cavity.

(2) *Swelling of the Submaxillary Lymphatic*

Glands.—The glands become enlarged, as in the case of empyema of the sinus, and are not adherent to the jaw.

(3) *Swelling in the parotid region,* only noticeable when the pouch is much distended. It may be abnormally hot and slightly painful.

(4) *Interference with swallowing and respiration,* observed when the pouch becomes greatly distended owing to stenosis or partial obstruction of the Eustachian duct, allowing the escape of a much smaller quantity of the contents than usual. The patient has difficulty in swallowing, makes a respiratory noise, and shows more or less dyspnœa during exercise due to the swelling encroaching on the pharynx and larynx.

(5) *Rupture of the pouch,* which rarely occurs, due to its excessive distension and repeated efforts of swallowing and snorting.

(6) *Holding the head towards the sound side* when the horse is being ridden, observed in some cases.

(7) *A rattling noise in the pouch during exercise,* sometimes perceived and due to agitation of the contents.

Diagnosis is based on: (1) the intermittency of the discharge; (2) its consistency and non-offensive nature; (3) the local swelling; (4) enlargement of the submaxillary glands; (5) the absence of characteristics of other conditions which cause a nasal discharge.

When in doubt Gunther's catheter may be passed through the inferior meatus of the nasal chamber and through the Eustachian tube into the pouch, whence fluid, if present, will escape through the catheter. The instrument is composed of metal and is slightly curved at its distal extremity. The pharyngeal entrance to the Eustachian tube is at the same level as the temporal canthus of the eye, and the distance from this point to the nostril is measured on the instrument and marked by a runner for the purpose. The catheter is introduced into the nose, and when it has entered as far as the point indicated by the marker the level of the Eustachian opening is reached, and the proximal end of the instrument must then be held close to the septum nasi so as to direct the other end outwards and enable it to enter the orifice, which is on the outer wall of the pharynx. To facilitate the passage of the instrument and to diminish the resistance of the horse, it should be immersed in warm water and smeared with vaseline before using it.

It requires considerable practice to acquire the necessary skill to make the instrument enter the Eustachian tube.

Prognosis.—There is no chance of spontaneous cure, but when the pus becomes inspissated and the quantity of liquid becomes diminished the functional disturbance is relieved. Death rarely supervenes from hæmorrhage due to ulceration of the mucous membrane and the opening of an artery, or to gangrenous pneumonia caused by alimentary matter gaining entrance to the lungs.

Treatment.—The treatment comprises:

(1) *Antiseptic inhalations,* which may be of some use in a recent case in allaying inflammation of the mucous membrane, but once pus has accumulated in the pouch they have no beneficial effect.

(2) *The passage of Gunther's catheter* to evacuate the fluid contents and to enable the cavity to be irrigated with an antiseptic or astringent lotion introduced through the catheter by means of a syringe. As it does not effect removal of the solid bodies or chondroids, this method of treatment is only palliative in its results and requires frequent repetition owing to the fluid being re-formed by the irritation caused by the solid matter remaining.

(3) *Operating* for the purpose of removing the liquid and solid contents through an opening in the external wall of the pouch. Before attempting to operate, and in order to understand the description of the operations performed, an accurate knowledge of the anatomy of the parotid and pharyngeal regions is essential, and to acquire it a work on anatomy should be consulted and the regions should be carefully dissected in the dead subject. There are several important vessels and nerves near the sites of operation, and if an intimate knowledge of their situations is not possessed by the operator he cannot proceed with confidence.

Methods of Operation.—The principal methods of operation are as follows: (1) Hyovertebrotomy; (2) Dieterich's method; (3) Viborg's method; (4) Puncture of the pouch through the parotid gland.

(1) HYOVERTEBROTOMY.—Introduced by Chabert and Fromage in 1822.

Control.—The operation may be done on the horse in the standing position fixed in stocks or controlled by a twitch, cocaine being used as a local anæsthetic. It is advisable to proceed in this way when the patient is affected with dyspnœa and asphyxia is endangered by casting. Otherwise, the recumbent position is more convenient, leaving the animal lying on the opposite side with the head held rigidly extended and generally anæsthetized if there be no obstruction to breathing. Provisional tracheotomy may be performed if there appear to be danger of suffocation.

Site of Operation.—The site of operation is the anterior edge of the wing of the atlas along the posterior border of the parotid gland. The posterior auricular nerve is close to the bone, and by operating about ⅜ of an inch in front of the latter the nerve can be avoided.

Operation. First Stage—Incision.—The skin having been prepared as usual, make an incision about two or three inches long parallel to the anterior border of the wing of the atlas, going through the skin and subcutaneous tissue, and exposing the parotid gland, which is recognized by its yellowish appearance, and taking care not to wound it or the auricular vein. Dissect carefully the gland from its posterior attachments and reflect it forwards. Have it held in this position by a retractor. Three landmarks can now be made out, viz. the great cornu of the hyoid bone in front, the styloid process of the occipital bone behind, and, between these two points, the glistening fibres of the occipito-styloid muscle.

Second Stage—Puncture.—Having the anterior lip of the wound well drawn forwards with the retractor, puncture the pouch with a sharp-pointed bistoury through the occipito-styloid muscle, parallel to its fibres, just above the heel-like process of the styloid cornu of the hyoid bone, the edge of the instrument being directed towards the latter or the tip of the nose, downwards and forwards. Do not allow the knife to enter the pouch further than half an inch, and withdraw it immediately, without making an incision, for fear of wounding the nerves and vessels in the vicinity.

If the edge of the knife be directed towards the atlas or the ear, the facial nerve, the posterior auricular artery, the internal carotid, and the nerves which accompany it may be cut, and if it be turned towards the larynx the hypoglossal nerve and external carotid artery may be severed.

When the pouch is much distended the nerves and vessels may be somewhat displaced. Nevertheless, operating in the manner described is without danger.

To enlarge the opening, insert the finger into it and forcibly separate the muscular fibres. Evacuate the contents by irrigation with a mild antiseptic lotion by means of a syringe.

Third Stage—Counter-opening.—Pass a sound into the bottom of the pouch and make it bulge out the tissues in the centre of Viborg's triangle, whose sides are the tendon of the sternomaxillaris above, the submaxillary vein below, and the vertical ramus of the lower jaw in front. Cut down on it here, making the incision parallel to the tendon. Enlarge the opening by breaking down the tissues with the fingers. Insert a piece of wide tape through the two openings to keep them patent and to ensure drainage.

This method has the desired effect when the contents of the sac are entirely liquid, but when chondroids are present it is difficult to remove them in this way.

2. Dieterich's Method.—*Site of Operation.*—The site of operation is the antero-inferior border of the wing of the atlas, between it and the parotid gland.

Operation.—Make the cutaneous incision and reflect the parotid gland as in the last case, exposing the posterior border of the mass of muscles formed by the digastricus, stylo-maxillaris, etc. Break down the areolar tissue to the inner aspect of these muscles until the angle between the external carotid and occipital arteries is reached, the vessels being recognized by the pulsation therein. Place the left index-finger in this angle dorsum upwards, and, passing the back of the knife along it, puncture the posterior wall of the pouch. Enlarge the opening by means of the fingers. By this method a large orifice can be made through which large chondroids can be extracted.

A counter-opening can be made as in the first method. When the pouch is not distended there may be difficulty in puncturing it in this region, owing to the loose attachment of its lining here.

3. Viborg's Method.—*The site of operation* is the centre of Viborg's triangle, described above.

Operation.—Make an incision parallel to the tendon of the sternomaxillaris two to three inches long, going carefully through the skin and panniculus, and exposing the parotid gland. Raise the inferior border of the latter by means of the finger, and break down the underlying tissue until the pouch is reached, and puncture it with the knife. Enlarge the orifice by tearing with the fingers.

A drainage-tube may be fixed in the opening, through which liquid can be injected into the pouch. This method has the advantage of making a dependent opening of sufficient size to permit of the extraction of large concretions.

4. *Puncture through the Parotid Gland.*—Locate the position of the jugular vein, which passes through the gland, and, selecting a point which is clear of it, incise the skin and pass a blunt sound through the wound into the pouch. This method is seldom adopted, having the disadvantage of going through the gland. It is only advisable when the pouch is very distended with fluid. The procedure is the same as that adopted for the opening of an abscess in the sub-parotid lymphatic gland.

After-treatment.—Wash out the pouch twice daily with a lukewarm antiseptic solution (potass. permanganate 1 to 1000). An astringent is indicated afterwards, such as sulphate of zinc 1 to 2 per cent solution.

When the discharge has ceased the operation wounds may be allowed to heal, the upper one first when two openings have been made. In a very chronic case, where the walls of the sac are thickened and indolent, the application of a blister may have a good effect in producing hyperæmia and restoring tone to the tissues.

Tympanites.—Tympanites of the guttural pouches has been seen in foals between the ages of two and twelve months. The condition is usually bilateral, and is generally due to the accumulation in the pouches of air which enters during expiration or the act of swallowing, and cannot gain exit owing to some defect in the Eustachian tube whereby it acts like a valve, allowing the inlet and preventing the outlet of air.

The condition has also been met with as a complication of catarrh of the pouches, the gas being apparently formed by decomposition of the exudate, and its escape being prevented by thickening in the orifice of the Eustachian tube diminishing or occluding its lumen.

Symptoms.—The symptoms are a diffuse, painless, elastic, tympanitic swelling in the parotid region. It may extend downwards and backwards towards the throat and upper part of the jugular furrow. There is resonance on percussion at the level of the pouch. When the cavity is greatly distended there may be interference with respiration and swallowing. The dyspnœa may be revealed by a respiratory noise. Pressure on the pouch may cause some of the air or gas to escape with a whistling sound.

Treatment.—The application of counter-irritants or other topics to the skin over the pouch has no beneficial result. Puncturing the sac gives only temporary relief, as it rapidly refills. When the condition is due to deformity of the Eustachian tube preventing free exit of the gas, it is necessary to open the pouch, by Dieterich's method for preference, introduce a grooved director into the Eustachian tube and, passing a narrow-bladed bistoury along its groove, incise the lower part of the tube in an anterior direction.

Even this procedure may not have the desired effect, and then the only course to adopt is to open the pouch externally in two places, above and below, and insert a drainage-tube to afford an exit for the air.

If the condition be associated with pus in the sac, treat for this condition.

Affections of the Salivary Glands.—Parotid Gland. Open Wounds.—When the parotid gland is wounded there is an escape of saliva through the wound. The latter heals in the ordinary way as a rule, a fistula seldom persisting.

Treatment.—Treatment is on the usual lines. Arrest the hæmorrhage by appropriate measures. If some of the large vessels are ruptured they must be promptly secured by artery forceps and ligatured. If this cannot be done through the wound, the vessel should be isolated at some distance from it and the ligature applied there. Even ligation of the common carotid may not stop persistent hæmorrhage from the internal carotid on account of the latter anastomosing with the corresponding artery on the other side. Suture and seal the wound.

Stenson's Duct.—Wounds of this duct may be transverse, longitudinal, or oblique, and partial or complete. During feeding there is a copious discharge of saliva from the wound. It is more difficult to obtain healing of the lesion in this case than in the gland on account of the greater quantity of saliva flowing through the opening in the canal. Consequently, when the wound is not promptly treated or is incapable of healing by first intention, a fistula frequently results. Rarely the proximal portion of the duct becomes obliterated, when atrophy of the gland follows.

Treatment.—Aim at healing by first intention. To promote this, perforate the cheek at the level of the wound, when the latter is near the mouth, to provide another passage for the saliva. Suture the cutaneous wound and seal it with collodion and iodoform. Do not give the patient any solid food for twenty-four hours, and avoid putting him in the company of horses that are feeding, in order not to excite salivation.

Salivary Fistula.—Salivary fistula may be due to a wound of the parotid or submaxillary salivary gland, or of Stenson's or Wharton's duct.

Etiology.—The fistula is usually from Stenson's duct, where it may be caused by an open wound or an abscess involving the canal.

Prognosis.—A fistula of the gland usually responds readily to treatment, and has a tendency to close spontaneously within a few weeks. It is much more difficult to effect closure of the orifice in the wall of Stenson's duct. But when there is a clear passage for the saliva into the mouth, suitable treatment of the external wound has the desired effect in this case.

Treatment.—When the condition is due to a recent incised wound of the gland or duct, endeavour to get healing by first intention as stated above. If the fistula has been in existence for some time, cauterization of its edges or freshening thereof and suturing will be necessary.

The application of silver nitrate, or of pure nitric acid with a glass rod, or of the hot-iron, or of a blister is often successful, provided that there is no obstruction to the flow of the saliva into the buccal cavity. Freshening the lips of the wound and inserting a purse-string suture is also frequently effectual in the same condition.

If the foregoing methods fail, one of the following procedures may be adopted for a fistula of Stenson's duct, situated on the cheek:

Clearing the Lumen of the Distal Portion of the Duct.—Pass a probe from the fistular orifice through the duct into the mouth. A few strands of thread may be attached to the instrument and drawn through the canal two or three times to clear it of inspissated mucus that may be present. The external opening is then treated as described, by cauterization, or suturing after freshening its borders.

Method I. Making an artificial Passage into the Mouth.—Perforate the cheek with a trocar at the level of the fistula, pass a few strands of silk thread through the passage and fix them in position by tying their ends at the commissure of the lips. Leave them in position for a few days until a permanent fistula into the mouth is formed. Then proceed to bring about closure of the cutaneous opening.

Method II.—Make a double perforation into the mouth from the fistula, pass a seton through both passages, and tie its two ends together in the mouth. By this method the external opening can be closed at once.

Method III.—Introduced in human surgery by Richelot. Perforate the cheek in two directions, viz. inwards to the mouth and outwards through the skin, from the fistula. Pass a seton through the two perforations, one end being in the mouth and the other outside the cheek, and close the cutaneous orifice of the fistula immediately.

Remove the seton after a few days.

The first method is simple and effective, and probably the most suitable in our animals.

Ligation of Stenson's Duct.—This is indicated in cases where healing of the fistula cannot be effected, or when the latter is situated far from the mouth where an artificial passage into the oral cavity cannot be made to replace the distal end of the duct when it is occluded. There are two sites for the operation :

Site I.—Operate at a point the width of two fingers from the posterior border of the lower jaw, and about half an inch behind the submaxillary artery, at the inferior border of the masseter muscle.

This method is only practicable when the fistula is close to the oral orifice of the duct, and then one of the above-mentioned modes of procedure is usually successful and therefore preferable.

Operation.—The animal may be controlled in the standing position under the influence of cocaine, or cast and anæsthetized locally or generally. Having prepared the skin, make an incision about an inch and a half long parallel to the duct, going carefully through the skin and subcutaneous tissues. The duct is recognized as a pale, collapsed vessel. Isolate it with a tenaculum and apply a silk ligature on it. Suture and seal the cutaneous wound.

Site II.—This site is chosen when the fistula is far from the buccal opening of the duct. It is located thus :

Take a point about one inch and a half behind the posterior border of the vertical ramus of the lower jaw at the level of the tendon of the sternomaxillaris and make an incision obliquely downward and forwards, following the course of the duct for a distance of about two inches.

Operation.—Taking the usual preliminary precautions incise the skin and the panniculus cautiously, to avoid cutting the duct which is superficially situated beneath the latter, and fairly difficult to recognize on account of its thin, almost colourless walls. Its diameter here is about half that of a lead-pencil. It is formed by the junction of two branches, one from the anterior and one from the posterior region of the gland, and one of these must not be mistaken for the main duct. It may be necessary to reflect the skin towards the jaw to reveal the structure. It is easily distinguished from a blood-vessel by its bloodless aspect. On being punctured with the point of the bistoury, a drop of glairy saliva escapes. Having found the duct, proceed as in the last case.

Results of Operations.—For some days after the operation the duct, above the seat of the latter, and the gland are distended with saliva, but subsequently the swelling gradually subsides and the gland undergoes atrophy and becomes functionless. Occasionally, after the ligature has severed the duct, the fistula re-forms. Two or three months may elapse before atrophy is accomplished.

Injection of Irritants.—Atrophy of the gland may be affected by the injection of irritants through the upper part of its duct, such as pure or dilute tincture of iodine, liquor ammonia (10 in 100), or Labat's preparation composed of tincture of iodine (20 or 40 parts), potassium iodide (1 part), and water (60 to 80 parts).

Several injections may be necessary before the desired effect is produced.

Fistula of the submaxillary gland or of Wharton's duct is a comparatively rare condition and readily responds to treatment by a blister or by cauterization.

Foreign Bodies in the Salivary Ducts.—Small particles of hay or awns of grass or oat grains may gain entrance to the main salivary ducts, usually Wharton's duct, and set up inflammation or suppuration : occasionally the foreign body causes little or no irritation, and simply serves as a nucleus round which salts are deposited to form a calculus.

Symptoms.—When inflammation arises it is revealed by swelling and redness of the buccal orifice of the duct, from which a fœtid, whitish pus may be oozing. There is excessive salivation.

Treatment.—Endeavour to expel the foreign body into the mouth by pressure on the course of the duct. If this fail, the oral orifice of the canal may be enlarged by an incision or Wharton's duct may be incised where it is distended, behind the barb.

Prescribe an antiseptic mouth lotion to be used for a few days afterwards.

Salivary Calculi.—Salivary calculi usually occur in Stenson's duct, rarely in Wharton's duct.

The size of the calculi varies; they are usually small, but exceptional cases of concretions weighing individually 7 to 12 ounces are recorded.

There may be several present, and then they are faceted from attrition.

An isolated calculus is generally oval in shape, smooth on its surface, and yellowish-grey in colour. The composition of the deposit is 80 to 90 per cent carbonate of calcium and 9 to 10 per cent organic matter, comprising salivary corpuscles and bacteria.

Etiology.—The condition is usually caused by a small particle of food-stuff getting into the duct and carrying with it bacteria which cause fermentation in the saliva and consequent deposition of lime on the foreign body. The latter may be a spicule of hay or grass, or an awn of oats or barley, or, rarely, a bit of dental tartar.

Symptoms.—The symptoms are a hard, painless swelling on the course of the duct, distension of the latter, behind the obstruction, and of the gland, and a grating noise when the skin is pierced with a needle at the level of the enlargement. There may be swelling round the buccal orifice of the duct when the stone is situated there.

The calculus may be a long time present without causing apparent inconvenience. Rarely an abscess forms in its vicinity.

Treatment.—If possible, force the calculus into the mouth and then remove it.

If it bulge into the oral cavity and cannot be pushed into the latter, incise the mucous membrane covering it and take it away. If the swelling be outside and of small dimensions, push the skin at its level aside and open the duct by a longitudinal incision just large enough to enable the calculus to be removed.

If the latter be large there is little object in displacing the skin before incising it, because it cannot be moved sufficiently to ensure the wound in the duct being covered by the skin when it reverts to its former position, but when the stone is small it may have this effect and thus favour early closure of the wound.

Having removed the obstruction, suture the cutaneous wound and seal it with collodion and an antiseptic powder. Give only liquid diet for a few days to diminish, as far as possible, the secretion of saliva, which is excited to a copious degree by dry food and tends to prevent healing of the wound by pushing its lips apart.

Healing by first intention commonly ensues; if not, it takes place by second intention, a fistula seldom persisting for a long time.

The external operation can be done on the horse standing, using cocaine, but for operation in the mouth it is necessary to cast the animal, insert a gag, and use a long-handled, blunt-pointed bistoury.

Tumours.—The parotid gland may be the seat of benign or malignant tumours, or of cysts. The commonest tumours in this region are melanomata, which often contain sarcomatous elements. They occur in grey horses as a rule.

Treatment.—If the tumour be benign and circumscribed remove it, taking care not to wound the important vessels and nerves in the vicinity.

If it be malignant or diffuse, it is better not to intervene. The removal of a wide-based tumour, to be radical in its effect, would necessitate extirpation of the gland, a rather delicate operation which is rarely indicated. It is not usual to intervene in the case of melanotic tumours.

Sub-parotid Abscess.—An abscess may form in the sub-parotid lymphatic gland, usually the result of strangles in the horse and tuberculosis in the ox. It causes a diffuse, painful inflammatory swelling in the parotid region. If not opened it will burst outside or inside, or in both situations, in the course of eight to fourteen days.

Mechanical pneumonia may supervene from the pus entering the larynx and bronchi, or a fistula of the pharynx may result. The inflammation is more diffuse and more deep-seated than that caused by parotitis.

Treatment.—Make a small incision in the skin over the most prominent part of the lower portion of the enlargement. Push a blunt sound or director through the wound into the abscess cavity, causing some of the pus to escape alongside the instrument. Withdraw the sound and introduce a blunt-pointed scissors, closed, into the abscess. Then open the scissors by forcibly pushing its handles apart and, holding it in this position, draw it out, thereby enlarging the opening by pushing the tissues aside without endangering any of the vessels or nerves in the region. Irrigate the cavity with a mild antiseptic lotion thoroughly to evacuate the pus. It may be possible to open the abscess with the finger after incising the skin.

J. J. O'C.

AFFECTIONS OF THE EAR

Examination of the External Ear.—The external ear can be readily examined by inspection and manipulation without the aid of an instrument.

An ear speculum may be used to dilate the concha, and natural or artificial light may be reflected therein to facilitate the exploration of its depth.

Traumatic Lesions.—The external ear, on account of its prominence and exposed situation, is subject to external injuries.

Contusions.—Contusions of the concha vary in degree in different cases. There may be merely extravasation of blood into the subcutaneous tissues, or a hæmatoma may form beneath the perichondrium, or the cartilage may be fractured.

The symptoms are the usual ones for a contusion, and the treatment is on general principles.

Open Wounds.—Open wounds of the flap of the ear are usually lacerated, being generally caused by bites in dogs and by being torn by barbed wire or nails in the large animals. In horses they may be caused by bites of other horses.

Treatment.—The treatment is as usual for open wounds, and comprises clipping of the hair from their edges, cleansing, disinfecting, and suturing them if possible. It is always desirable to immobilize the ears in the dog, to prevent shaking of them and interference with the healing process. This may be effected by a layer of cotton-wool applied over the wound and kept in position by a cap, securely fixed by strings intercrossed beneath the throat and tied over the poll and forehead, the flap of the ear being either turned down and compressed against the parotido-temporal region or turned backwards in contact with the occipital region. Excessive pressure must be avoided in long ears for fear of causing necrosis of their tips.

The dog has a great tendency to rub the affected ear on the ground or scratch it with a paw, so that the bandage or cap requires to be very securely fixed in this animal. A special cap of canvas or strong netting, kept in position by buckles and straps, may be used.

If the wound be not recent and in the form of a fissure through its border, it will be necessary to freshen its edges before suturing them, otherwise healing by second intention will ensue, each border cicatrizing separately and leaving a permanent slit in the concha.

It may be necessary to tie the horse on the pillar-reins to prevent his rubbing the ear against the manger or side of the stall.

In the case of fracture of the base of the concha, displacement of the edges of the fracture may occur, causing more or less occlusion of the entrance to the auditory meatus. Treatment of this condition is not necessary, and is not likely to have much effect.

When the injury is very severe necrosis may supervene, causing loss of a variable portion of the external ear.

Hæmatoma.—A hæmatoma or collection of extravasated blood and serum beneath the perichondrium of the flap of the ear, usually on its inner aspect and rarely on the outer aspect, or in both situations, is a common condition in the dog.

Etiology.—The lesion is due to the rupture of blood and lymphatic vessels, caused by incessant shaking of the head and scratching the ear with a paw as the result of irritation of the interior of the concha, brought about, as a rule, by aural canker.

The affection is most common in long-eared dogs, but it occurs in all breeds, and is sometimes seen in the cat.

Symptoms.—A fluctuating swelling appears in the flap of the ear, usually on its inner aspect, occupying the greater part of its surface from its tip to its base.

It is more or less inflammatory, showing a variable degree of abnormal heat and hypersensitiveness. If infection gain entrance suppuration will ensue.

Treatment.—The application of absorbent topics to promote absorption of the enlargement is of no avail.

It is necessary to incise the swelling on the middle line from its upper to its lower extremity, evacuate its contents, and treat the lining of the cavity with an irritant, like tincture of iodine, to bring about inflammation, granulation, and cicatrization. After healing has taken place, the subsequent contraction of the scar-tissue causes puckering and a variable amount of deformity. To keep the quantity of cicatricial tissue as small as possible and cause immediate and permanent union between the skin and the cartilage, thereby minimizing the deformity mentioned, the following procedure is generally effective:

Having operated on the swelling as described, insert a series of interrupted sutures through the ear, across the edges of the wound, and tied on the outer surface of the flap. Immobilize the ear with a pad and bandage or cap. Healing of the opposed surfaces may occur by first intention. Frequently, however, the desired effect is not produced.

If this method be not adopted, or prove a failure, the wound must be kept open until the cavity fills with granulations from its periphery. Otherwise the cutaneous wound will rapidly heal and the swelling will reform. After suturing, it is also necessary to examine the wound daily and squeeze out with a pledget of cotton-wool any discharge that may accumulate beneath the skin on either side of the sutures. The consequent deformity is more marked or more noticeable in short ears.

Necrosis of the Conchal Cartilage.—Necrosis of the concha is most common in the horse, and is the result of an open wound and infection of the cartilage.

Symptoms.—The symptoms are those of a sinus, there being an inflammatory swelling with one or more orifices discharging a greyish, fœtid, and sometimes blood-stained pus. The ear becomes deformed from contraction of the fibrous tissue replacing the destroyed cartilage.

Treatment.—The treatment is on the usual principles for a sinus, comprising opening up of the passage, providing for drainage, the injection of antiseptic or irritant liquids, or mechanical removal of the necrotic cartilage with the knife or curette.

When the ear is extensively diseased it is necessary to amputate the concha as follows: cast the horse on the opposite side, have the head well extended, prepare the site of operation, inject a solution of cocaine hypodermically, make an incision encircling the concha about one inch from its base, dissect back the skin and the upper border of the parotid gland for a short distance, divide the auricular muscles in this situation, ligature the anterior auricular artery, sever the ligament uniting the cartilage to the auditory meatus, and remove the former. Apply a pad of gauze over the meatus to prevent the entrance of blood therein, and suture the skin in front of and behind the orifice.

Healing occurs in the course of a fortnight. The scutiform cartilage is seldom affected with necrosis. The condition is treated in the same way as that of the concha, the cartilage being easily dissected out and removed if necessary.

Ulceration of the Concha.—This condition is most common in long-eared dogs, in which it is usually the result of a wound which is prevented from healing by the constant shaking of the ears, or by rubbing them on the ground or scratching them with a paw.

The ulcer is usually situated towards the border of the flap, but the inner aspect of the latter may become ulcerated when affected with canker or otorrhœa.

Treatment.—The first indication is to remove the cause of the condition by arresting the shaking of the ears, or treating canker when it is present. The ears may be immobilized in the manner described in connection with wounds of the ear. If the ulcer be of long standing and too callous to granulate and cicatrize, it should be cauterized with silver nitrate, or stimulated by the application of a little biniodide of mercury ointment, rubbed into the skin in the vicinity and smeared over the ulcer. Otherwise thorough cleansing of the lesion and dressing it with iodoform powder prove sufficient with immobilization. The passage of a couple of setons through the ear in the vicinity of the ulcer is a method often used with success in obstinate cases.

Foreign Bodies and Parasites in the Ear.—Foreign bodies seldom remain lodged in the ear, but occasionally inspissated wax or cerumen, or a pebble or a piece of wood, or a bit of grass is found there, causing irritation and inflammation if a long time *in situ.*

Parasites or insects such as flies, fleas, and acari may also gain entrance to the concha and act as irritants.

Symptoms.—Attention is attracted to the ear by repeated shaking of the head and scratching of the ear with a paw. The patient may whine from the pain or irritation caused by the foreign matter or parasite.

Treatment.—A strong jet of lukewarm water introduced by means of a good-sized syringe generally has the effect of dislodging and expelling the offending object. A forceps or a blunt curette may also prove useful for removing it. If inflammation is present treat accordingly. A piece of cotton-wool wrapped round a pen-handle and smeared with vaseline may be used for the removal of parasites, which adhere to the ointment.

Tumours.—Tumours are found affecting the ears of all the domesticated animals. They comprise papillomata, polypoid fibromata, and sebaceous cysts.

Papillomata or warts are most common in cattle, in which they often appear in clusters. Sebaceous cysts are found inside the base of the ear in the horse. Fibromata and sarcomata also occur in this animal. Polypi, sessile or pedunculated, are most frequently seen in the dog, affecting the lower portion of the interior of the concha, where they are almost invariably due to chronic otorrhœa. There may be a discharge from the ear of a fœtid liquid, sometimes blood-stained.

When both ears are affected the patient is quite deaf.

Treatment.—The treatment is excision of the tumours. Pedunculated growths can be readily cut off with scissors, while those with a large base may be dissected with a sharp, narrow-bladed bistoury. The base of the tumour may be cauterized to destroy any trace of it that may remain.

Malignant neoplasms such as sarcoma and carcinoma require complete amputation of the concha or cartilage on which they are situated, and if the surrounding tissues are involved operation will be useless, as the tumours are then sure to recur even after complete excision and cauterization of their site with the hot iron.

J. J. O'C.

AFFECTIONS OF THE PHARYNX AND LARYNX

Traumatic Lesions. Open Wounds.—Open wounds of the pharynx in the horse may be caused by a sharp-pointed stick used to administer a ball, or by dental instruments incautiously employed or accidentally slipping from the teeth and coming in contact with the pharyngeal walls. A foreign body lodged in the pharynx may wound its lining or perforate its structure, and gain exit through the skin by provoking an abscess which bursts externally. Rarely, the pharynx is wounded from without inwards.

Symptoms.—Hæmorrhage may occur through the mouth or nose and symptoms of pharyngitis supervene, characterized by difficulty in swallowing, alimentary matter being returned by the nostrils, and by salivation.

Septicæmia or pyæmia may ensue from virulent infection of the wound. A fistula may be present as the result of perforation of the pharyngeal wall.

Treatment.—Treatment is that for pharyngitis, and little can be done except to prescribe semi-liquid demulcent diet and antiseptic and astringent electuary containing borax or potassium chlorate, which may be associated with an anodyne like the green extract of belladonna.

A recent fistula with clean-cut edges may be sutured through the skin, and one of long standing must be cauterized or freshened and closed with a purse-string suture.

Foreign Bodies.—A foreign body may be lodged in the pharynx of any animal, but most commonly in that of the dog and cat, in which the object may be a piece of wood or bone, a pin, a needle, or a fish-hook.

In the horse and ox the foreign body may also be a piece of wood, a needle, a bit of wire, a hair-pin, or part of a root or tuber, etc. A portion of potato or root may lodge in the pharyngeal pouch of the pig.

Symptoms.—The symptoms are those of choking or more or less obstruction of the entrance to the œsophagus, and comprise coughing, dysphagia, or inability to swallow, salivation, evidence of distress or discomfort revealed by an anxious expression and by uneasiness, and attempts at vomiting in the dog and cat.

In the small animals the offending object can be readily detected by opening the mouth widely and depressing the base of the tongue.

In the larger species it may be felt by the hand. In the ox it can be reached in any part of the pharynx, but in the horse it cannot be manipulated if it is further back than the level of the epiglottis.

Treatment.—Extract the foreign body by means of the hand or forceps or a hook. The hand alone is usually sufficient in the ox, but in the horse it may fail to reach the object, and a forceps or hook may then answer the purpose. An artery forceps is convenient for use in the small animals. In all cases the patient's jaws should be kept separated by a speculum. When a sharp-pointed body, such as a needle or pin, is left *in situ*, it eventually finds its way out through the medium of an abscess, bursting in the region of the throat.

Parasites.—Cases are recorded as occurring in Spain and Northern Africa of blood-sucking parasites taken in in the drinking-water becoming fixed on the mucous membrane of the pharynx and larynx. The engorged parasites may burst, causing the escape of blood from the nose. They may give rise to anæmia and debility. Affecting the larynx they cause a varying degree of dyspnœa which may amount almost to asphyxia.

The larvæ of the *Œstrus equi* have also been found in these situations, producing similar symptoms.

Treatment.—It has been recommended to put eels in the drinking ponds, as they devour the parasites. Suspected water should be filtered before being given to animals to drink. Fumigation by pitch or tobacco seldom has much effect on the pests, which are best removed directly by means of a piece of stick whose end is furnished with a sponge or pad impregnated with ether. They may also be taken off by the aid of forceps, or the hand alone when within reach.

Tumours.—Actinomycotic tumours are common in the pharynx of the ox. Apart from these, pharyngeal neoplasms are comparatively rare in veterinary practice. Fibromata, sarcomata, and epitheliomata are occasionally met with.

Symptoms.—The symptoms are those of chronic pharyngitis with more or less pronounced dysphagia. Dyspnœa and a respiratory noise may supervene from encroachment of the tumour on the air passage. A pedunculated growth often becomes displaced by the act of swallowing, especially during feeding, when it may obstruct the entrance to the œsophagus and give rise to a fit of coughing which ejects the food material through the mouth and nose. If the pedicle is long the tumour may fall into the lumen of the larynx and produce sudden dyspnœa, which is relieved by the animal coughing and expelling the obstruction. Rarely, death supervenes from asphyxia owing to the patient being unable to dislodge the obstacle in this way.

If the enlargement involves the posterior nares it causes snoring and a variable amount of dyspnœa, according to its size, especially during feeding; or rumination in the ox. When an attack of severe dyspnœa occurs due to sudden obstruction of the larynx by a polypus, the animal becomes greatly distressed and appears to be fighting for breath, pawing the ground, heaving at the flanks, and evincing an anxious expression with dilated nostril. When the tumour is coughed out of the passage the patient becomes normal again.

In the dog and cat vomiting is sometimes induced by the presence of the tumour in the fauces.

Diagnosis.—Diagnosis may be confirmed by external examination of the pharyngeal region, where a large tumour can be felt by manipulation when the head is extended, or by exploration through the mouth, which is easy in the ox and small animals but difficult in the horse on account of the length of the soft palate and of the jaws, or through the larynx after performing laryngotomy, or through the nose by the aid of a sound passed in through the nostrils. The rhino-laryngoscope would prove very useful in cases where diagnosis is difficult.

Prognosis.—Generally speaking, the prognosis is grave. Sessile tumours, whether malignant or benign, are inoperable. Pedunculated growths can generally be removed.

Actinomycotic swellings respond to internal medication. Malignant growths are incurable.

Treatment.—Inoperable actinomycotic tumours can be treated successfully by the internal administration of potassium iodide or biniodide of mercury. (See "Actinomycosis.")

Pedunculated growths may be removed by one of the following methods :

1. *Through the Mouth.*—If there is danger of asphyxia during the operation, perform provisional tracheotomy and insert a tube. Have the animal rigidly held or secured in stocks, and the mouth kept open with a speculum.

If there be difficulty in operating in the standing position cast the patient, making use of the ecraseur, pass the loop of chain round the pedicle of the tumour and sever it by slowly turning the handle. The growth might also be grasped by a long forceps and removed by torsion.

2. *Through the larynx,* after performing laryngotomy, not practicable as a rule.

3. *Through an external wound* in the pharyngeal wall made either at the level of the middle line of the larynx and hyoid bone, the pharynx being entered just in front of the epiglottis, or just beneath the wing of the atlas, parallel to the jugular vein, the cavity being reached by blunt dissection of the tissues in the angle of bifurcation of the carotid into its terminal branches, and by puncturing the mucous membrane with a knife. This method is not likely to prove practical or beneficial.

It may be said that if operation by the mouth is not possible the case is hopeless.

Examination of the Larynx.—The larynx can be examined externally by observation and palpation in the large and small animals. By keeping the head extended the organ becomes more prominent and more easily explored. Internally the larynx can be felt by the hand in the ox but not in the horse, where a point further back than the base of the epiglottis cannot be reached.

In the dog and cat the larynx can be easily seen when the mouth is well opened and the base of the tongue is depressed with a spatula, and it can be satisfactorily illuminated by the aid of a mirror and artificial light. For the horse the rhino-laryngoscope affords a clear and definite image of the larynx.

Traumatic Lesions.—*Contusions.*—The larynx may be affected by a contusion which seldom presents characters differing from those of this lesion elsewhere.

Sudden cessation of respiration and syncope have been known to follow a severe blow inflicted at the level of the larynx and upper part of the trachea in front of the neck. The symptoms and treatment of the condition are those of contusions in general.

Open Wounds.—The larynx may be wounded from the outside or by way of the mouth and pharynx, more commonly in the former manner. In the latter case the wound may be caused by a probang, or an instrument used on the posterior part of the mouth or in the pharynx, being accidentally passed into the larynx. Laryngotomy furnishes an example of a surgical wound of the larynx.

Symptoms.—When the lesion is produced externally the symptoms are the ordinary ones of an open wound, and in addition there may be emphysema of the tissues due to the cutaneous wound and that in the larynx not being confluent, and profuse bleeding into the larynx which may lead to asphyxia. When the trauma is confined to the interior of the organ there may be bleeding from the mouth and nose, and symptoms of laryngitis with more or less dyspnœa will supervene. Asphyxia may ensue from severe laryngeal hæmorrhage or œdema, and broncho-pneumonia is a possible complication.

Treatment.—The treatment is on general principles. If the deep and superficial parts of the wound do not communicate freely causing emphysema, make them confluent by the use of the knife.

If asphyxia is threatened from hæmorrhage into the trachea, perform tracheotomy and insert a tampon cannula, that is, a tube in one piece with a cylindrical bent stem which fits into the trachea and is enveloped in gauze to prevent the passage of blood into the lungs.

Even a clean incised wound penetrating the larynx, like that made in laryngotomy, is better left open, as suturing favours œdema and prevents the escape of inflammatory discharge. When the cartilage is not damaged, healing without complications takes place, but if one of the cartilages is wounded excessive granulations are likely to form in the affected part, resulting in fibrous thickening or ossification of the larynx with diminution or almost obliteration of its lumen and consequent dyspnœa, and asphyxia if relief is not afforded by the performance of tracheotomy.

There is usually a very fœtid odour from the wound extending into the larynx. It is insignificant.

Internal wounds of the larynx can only be treated as laryngitis. If they cause dangerous dyspnœa, tracheotomy will be necessary. Antiseptic inhalations are indicated.

Fractures of the Larynx.—The larynx is very rarely fractured.

The lesion is due to external violence, such as a kick or a horn-thrust, and causes dyspnœa from the inflammatory swelling which ensues.

Bleeding may occur from the mouth and nose owing to laceration of the laryngeal mucous membrane. Tracheotomy is usually necessary to prevent asphyxia.

Foreign Bodies in the Larynx.—There are many cases on record of foreign bodies in the larynx. In all cases of dysphagia there is a tendency for food material or medicine being partaken of or administered passing into the larynx, for example, in a case of sore throat, milk fever, or tetanus.

In dogs playing with objects in the mouth these are apt to fall into the pharynx and be accidentally aspirated into the larynx. Besides ordinary alimentary matter and drugs, other solid bodies may become lodged in the laryngeal orifice, such as a needle, a pin, or a piece of wire, etc.

Symptoms.—When foreign matter enters the larynx it excites coughing, which often serves to expel it. Should it fail to do so, dyspnœa, varying in degree according to the amount of obstruction, supervenes. Repeated ineffectual coughing may occur, and difficulty in swallowing may also be noticed should the patient attempt it.

Asphyxia is caused when the lumen of the organ is entirely occluded.

Diagnosis.—Diagnosis may be difficult.

The condition may be confounded with obstruction in the pharynx or œsophagus. Passage of the œsophageal tube or probang will show that the gullet is clear.

In the ox, manual examination may reveal the nature of the case. In the small animals the object may be seen when the mouth is widely opened and the base of the tongue depressed with a spatula.

Treatment.—Remove the foreign body by means of a forceps or hook introduced through the mouth, which is kept open by a speculum.

This method is not practicable in the horse, in which laryngotomy will be necessary to gain access to the interior of the larynx.

J. J. O'C.

FISTULOUS WITHERS AND POLL EVIL

Fistulous Withers

Under the heading of "Fistulous Withers" all the traumatic lesions of the back and withers which may lead to this condition must be considered as well as itself. The lesions which may exist here comprise :

(1) Excoriations ; (2) a gall ; (3) a hæmatoma ; (4) a sit-fast or area of necrosis ; (5) bursitis ; (6) an abscess ; (7) an open wound ; (8) fracture ; (9) a sinus or "fistulous withers."

Etiology.—All the above affections are of traumatic origin, the injury in most cases being caused by the harness. When an abscess or a sinus supervenes, it is due to infection having gained entrance through a breach of surface of the integument.

There are predisposing causes which deserve to be mentioned, including the following :

(1) *Low withers,* allowing the saddle to be displaced forwards. (2) *High withers,* which are apt to be compressed by the pommel or front arch of the saddle. (3) *Narrow chest,* making it difficult to tighten the girths, and causing the saddle to move during work. (4) *Poor condition* of the animal leaving the bones insufficiently covered or cushioned by soft tissues, and making the spinous processes of the vertebræ more prominent. (5) *Faulty adjustment or construction of the saddle.* (6) *An awkward or tired rider* who does not balance himself properly, thus causing unequal distribution of the pressure on the back and displacing the saddle. (7) *Working in hilly country* causing movement of the saddle during the ascent and descent of slopes. (8) *Ill-balanced pack saddles.* (9) *Sweating,* or the skin being wet from rain, causing it to adhere to the lining of the saddle and to move with the latter, thereby rupturing the cutaneous or subcutaneous fibrous tissue, and giving rise to infiltration of serum therein and the formation of a gall.

When there is a combination of these circumstances, bad effects are more likely to be produced.

1. **Excoriations** are due to chafing by movement of the saddle, the epithelium becomes softened by the sweat and detached from the corium, which appears red and inflamed, and covered with an exudate which afterwards dries to form a scab. The affected part is very sensitive and the animal resents its back being touched.

Treatment.—Consists in applying an antiseptic powder and resting the subject until the lesion heals under a scab.

2. **Galls** are the result of contusion or excessive pressure of the saddle on the affected parts, or of laceration of the cutaneous or subcutaneous fibrous tissue due to adhesion of the skin

to the lining of the harness, and movement of the latter. Infiltration of serum takes place into the cutis or subcutis or beneath the fascia, causing the formation of raised circular inflammatory areas, varying in dimensions from a shilling to a five-shilling piece, easily felt by passing the hand over the saddle-seat, and painful on pressure.

The gall may not form until after the saddle has been removed, when it is caused by the inrush of blood to the capillaries, which have been paralysed by pressure and consequently dilate excessively or rupture with the results mentioned.

Subfascial galls generally occur on the withers, and are the most painful form of the condition. The other varieties are mostly found on the seat proper of the saddle.

Cutaneous galls disappear in the course of eight to ten days, subcutaneous ones are slower in undergoing resolution, and subfascial enlargements are still more difficult to get rid of.

Treatment.—A gall may sometimes be prevented by leaving on the saddle for about half an hour after the horse comes in from work, so as to allow the blood to return gradually to the anæmic vessels, and thus prevent their rupture from sudden forcible distension.

When the lesion exists it must be treated as a contusion, first by cold and astringent lotions to prevent further infiltration, and afterwards by moist heat, absorbent topics, and massage to promote absorption of the infiltrate.

3. **Hæmatoma.**—A hæmatoma is a form of gall due to accumulation of extravasated blood in a cavity beneath the skin. When slight it undergoes absorption in the course of some days or weeks, but when large it persists as a sort of cyst.

Treatment.—Treatment is the same as in the case of an ordinary gall at first, but when the swelling persists beyond a reasonable time it must be opened and evacuated of the serum and fibrin which it contains, and its lining must be treated with an irritant like tincture of iodine to bring about inflammation, granulation, and cicatrization.

Strict antiseptic precautions must be taken to prevent sepsis and the possible complication of " fistulous withers."

4. **Sit-fasts.**—A sit-fast is a patch of necrosis affecting the skin and subcutaneous tissue to a varying depth, due to arrest of the circulation in the affected region by the pressure of the harness.

The necrotic portion is cone-shaped, the base of the cone being formed by the skin. After some days a line of demarcation or reaction forms, at the level of which the dead becomes separated from the living part, a trench being formed in which suppuration takes place.

Treatment.—The treatment consists in hastening, as far as possible, the removal of the dead tissue. This may be effected by applying a counter-irritant, such as a little biniodide of mercury blister, round the affected part to produce hyperæmia and intensify the inflammatory process by the agency of which the slough is cast off.

When the sit-fast is partly detached it should be excised with a knife.

When the trench surrounding the necrotic portion is deep and pus accumulates therein, a counter-opening should be made to provide drainage and prevent further destruction of tissue from stagnation of the pus.

5. **Bursitis.**—In most horses there is a bursa between the funicular portion of the ligamentum nuchæ and the spines of the first four dorsal vertebræ. This may become affected with bursitis, causing a fluctuating swelling which is more or less painful, according to the intensity of the inflammation, and is frequently bilobed.

The distension of the bursa may extend beneath the trapezius or rhomboideus muscle. The condition may be confused with an abscess, and diagnosis can only be made certain by an exploratory puncture with a fine trocar and cannula.

Treatment.—The lesion must be treated as an ordinary bursitis or inflammatory condition. If it is recent and acute, cold and astringent applications are indicated, which have the effect of allaying the inflammation, but often fail to dispel the swelling, which remains as a cystic enlargement or hygroma, of which the treatment may be :

(1) *Counter-irritation* by a blister or the actual cautery. The former is seldom of much benefit. The latter, especially in the form of penetrating needle-points, is often very effective.

(2) *Aspiration and injection* of an irritant such as tincture of iodine, pure or diluted with two parts of distilled water. This is often effective, but may require to be repeated several times at intervals of two to four weeks before complete cure occurs.

When the cyst contains solid, rice-like bodies, this line of treatment is of little use.

(3) *Incision and evacuation* of the contents is the only procedure that can bring about cure of a hygroma containing the solid particles mentioned. It has the disadvantage of exposing the tissues to infection, which may result in fistulous withers, if careful antiseptic precautions are not observed.

6. **Abscess.**—An abscess may occur as a primary lesion or be secondary to bursitis or a hæmatoma from these conditions becoming infected. It may be superficial or deep, and centrally or laterally situated. Strangles may be the cause of an abscess in this situation. Exploratory puncture will confirm the diagnosis when it is doubtful.

Treatment.—When the abscess is deep, rubbing in a vesicant is useful in bringing the pus nearer to the surface before using the knife to allow of its escape. The incision should be made longitudinally, because if made transversely, it will gape considerably, take a long time to heal, and leave a larger scar. A counter-opening may be necessary to provide drainage. If the cavity contain necrotic tissue, it will require to be irrigated once or twice daily with a disinfectant until the interior becomes clean and uniformly covered with granulations. A sinus may supervene constituting "fistulous withers."

7. **Open wounds** when deep, involving the ligamentum nuchæ or supra-spinous ligament or the dorsal spines, are serious as they are very likely to be complicated by necrosis of these structures. They are treated on general principles.

8. **Fracture** of the dorsal spines is a rare condition due to severe external violence. It may be simple or compound. The former is diagnosed by crepitation, and in the latter the fracture may be visible through the wound.

Simple fracture heals with rest.

Compound fracture may be followed by necrosis of the bone as the result of infection through the open wound.

Treatment.—Treatment is only necessary for compound fracture, to prevent sepsis by disinfection of the wound, and to remove loose splinters of bone if present.

Fistulous withers is a sinus in the region of the withers. It is due to a traumatic lesion becoming septic and the bacteria reaching the deep-seated structures of feeble vascularity, which consequently undergo necrosis, causing constant suppuration and perpetuating the condition until the necrotic tissue is removed. The structures involved may be the subcutaneous fibrous tissue, the ligamentum nuchæ, the supra-spinous ligament, the dorsal spines, the dorsal transverse processes, the upper part of the ribs, the cartilage of prolongation of the scapula, and the scapula itself.

Symptoms.—The symptoms are those of a sinus associated with more or less severe inflammation. There is one or more orifices discharging pus. Exuberant granulations may be present at the entrance to the sinus. The swelling, usually well marked, is always very sensitive to the touch, and is situated in one or both sides of the middle line. The depth of the lesion varies in different cases. A probe passed in through the opening may fail to reach the extremity of the cavity owing to the passage being tortuous. The pus may burrow downwards to near the level of the elbow.

Some of the openings may have healed, while new ones have formed by the bursting of secondary abscesses. When the lesion is long-standing the affected tissues become indurated. When the discharge is copious it indicates that there is extensive destruction of the deep-seated structures.

Prognosis.—Generally speaking, the prognosis should be guarded. The condition is always troublesome and tedious to deal with. It usually necessitates extensive incisions to expose the diseased tissue and permit of its removal, and to provide for drainage. When this is effectively done, healing takes place within a period of two to six weeks, depending on the depth and area of the affection. When the bone is diseased the case is more serious because of the depth of the lesion, and the tendency of the osseous tissue to be reinfected after its necrosed surface has been curetted or scraped. When suppuration extends deeply to the inner aspect of the scapula, it is difficult to treat the condition satisfactorily, and when this bone is affected with necrosis it may be hard to locate the seat of the disease, and its effective treatment requires a drastic use of the knife, and the formation of alarming wounds which will take weeks to heal.

The case may appear to do well for a while, when renewed inflammation occurs owing to the formation of a secondary abscess due to reinfection, or to a portion of necrotic tissue having escaped detection at the time of operation, and being left *in situ.* Rarely the intervertebral ligament is penetrated, leading to paralysis and death from interference with the spinal cord. The patient, in bad cases, loses condition as the result of pain and toxæmia, and may succumb to the latter or to pyæmia or septicæmia.

Treatment.—The principles of treatment are simple, being those of a sinus, and comprising :

(1) *Antiseptic injections,* which may be sufficient to overcome the bacteria in a recent case, while the necrotic tissue separates and comes away with the discharge. They are generally disappointing.

(2) *Caustic injections,* composed of perchloride of mercury, 1 to 10 of spirit, chloride of zinc, 10 per cent ; saturated solution of sulphate of copper or sulphate of zinc, etc., which are often effective, promoting separation of the diseased parts, and having powerful germicidal properties.

(3) *The use of solid caustics* such as corrosive sublimate, sulphate of copper, or chloride of zinc pushed into the depth of the cavity, where they cause an eschar or core which on separating takes with it the original necrotic tissue, leaving a healthy granulating wound, provided that the agent reaches the affected parts. It is generally necessary to enlarge the opening of the sinuses to enable the drug to be satisfactorily introduced.

(4) *The introduction of a seton,* smeared with

a caustic, through the sinus, to produce the effect mentioned in No. 3, and to act as a drain by keeping the openings patent.

(5) *Operation* to open up sinuses, expose and remove necrotic callous tissue, to scrape necrosed bone and, if necessary, to make counter-openings, strict antiseptic precautions being taken to prevent reinfection.

A careful search is often necessary to prevent secondary passages being overlooked. Cavities should be plugged with antiseptic gauze, wool, or tow to arrest the hæmorrhage and keep their walls apart until the following day, when the plug should be removed. The use of the syringe is indicated to flush out debris after operation. Tincture of iodine is a useful preparation for swabbing the interior of the wound after excision of the diseased tissue.

The after-treatment comprises daily irrigation with an antiseptic solution and the insufflation of an antiseptic powder such as a mixture of iodoform and boric acid, or permanganate of potash and boric acid (1-10 or 1-20).

When the wound is granulating uniformly the lotion should be discontinued, except for application to its periphery, but the dry dressing should be continued until healing occurs. Vaseline should be smeared beneath the wound to prevent discharge adhering to and excoriating the skin.

When there is a lesion of the bones it is advisable to cover the withers with a sterilized pad, made by stitching a layer of cotton-wool covered by gauze to a clean stable-rubber. The latter is fixed in position by means of a roller placed behind the wound and by strings round the neck. If a protection of this kind is not afforded, it is difficult to prevent contamination of the wound in the bone from the dust in the stable, especially when situated on a prominent dorsal spine which is not covered by skin.

(6) *The use of bismuth paste*, composed of wax, vaseline, paraffin, and subnitrate of bismuth. This is recorded as having had excellent results in the treatment of sinuses in various parts of the body. The necrotic tissue should be removed before introducing the preparation.

(7) *Carrel's tube treatment* of septic wounds by continuous antiseptic irrigation, as carried out by Captain Peatt, A.V.C., in Salonika, and described by him in the *Veterinary Journal* (Vol. 74, No. 4).

This treatment has had remarkable success in the hands of Captain Peatt.

(8) *The use of an autogenous vaccine,* which is often very effective, causing prompt healing of the lesion.

(9) *The hypodermic injection of nuclein* to increase phagocytosis and counteract the effects of the bacteria. It has often proved very beneficial.

Poll Evil.

The term "poll evil" is sometimes applied to any inflammatory affection of the poll, but the typical condition which has given rise to the name is a sinus in this region.

The lesion on the poll may be: (1) A contusion; (2) a hæmatoma; (3) a sit-fast; (4) an open wound; (5) a bursal enlargement; (6) an abscess; (7) a sinus.

The subject might be briefly dealt with by referring the reader to the general surgery of these conditions.

They are all due originally to direct injury of the region such as may be caused by a blow, striking the poll against the manger, the top of a doorway, a ceiling, or the roof of a pit, or something dropping from the latter on the poll, falling backwards the occipital region striking the ground, or the pressure of a heavy bridle or a tight overcheck. An abscess and a sinus are due to the entrance of infection, which in the latter case causes necrosis of the ligamentum nuchæ, and sometimes necrosis or caries of the occiput or atlas as well.

Each of the above conditions is dealt with individually in the preceding article on "Fistulous Withers," and they are practically the same occurring on the poll.

Symptoms.—The symptoms vary according to the nature of the affection, but in every case there is more or less interference with movement of the head on the neck, the patient holding the former stiffly at a lower level than usual with the nose poked forwards. In acute inflammatory lesions this interference with movement is very striking and pain is very intense, the animal resenting the slightest pressure on the affected part.

In the case of a sinus or typical "poll evil" there is a more or less extensive inflammatory swelling on one or both sides of the middle line showing one or more purulent orifices. The strong funicular portion of the ligamentum nuchæ prevents distension of the mesial aspect of the region.

When the disease is long in existence the enlargement is indurated, due to the development of a large amount of fibrous tissue. The discharge is always copious owing to the great destruction of tissue in the depth of the lesion.

A probe passed into the sinus gives an idea of the extent of the purulent cavity, and if the bone is affected it may grate on its rough surface.

Exceptionally the occipito-atlantoid articulation becomes affected with a dry arthritis which results in anchylosis of the joint, and incurable rigidity of the head on the neck. Secondary deep-seated abscesses may form causing intense pain during their development, and giving rise to febrile disturbance. The subject then stands motionless with the head low and extended, and sometimes resting on the manger. When the abscess bursts considerable relief is obtained. Pressure of a deep abscess may be transmitted through the thin occipito-atlantoid capsular ligament to the spinal cord and cause paralysis. Rupture of this ligament may rarely supervene, and lead to sudden death from interference with the central nervous system.

Treatment.—The treatment will vary according to the character of the condition as described in the case of Fistulous Withers. Incision for an abscess or the enlargement of an opening or the production of a dependent orifice should be made longitudinally in order to have as little gaping of the wound as possible, and thus favour cicatrization afterwards.

When a recent abscess is opened healing may occur at once, or more commonly a sinus supervenes owing to the presence of necrotic ligament.

It is impossible to get perfect drainage from a cavity abutting on the occiput, as there is no way of making an outlet laterally, and the occipital crest forms a barrier in front.

Despite this, however, recovery may supervene provided that necrosis is absent. In every case of a sinus the ligamentum nuchæ is necrotic, and cure is impossible until the dead portion is removed. This may be effected by the use of solid caustics or a caustic seton, but the surest procedure is to operate as follows :

Clip off the mane and forelock and the hair in the vicinity of the affected region, and shave the skin on the middle line from a point in front of the occiput to a point behind the posterior extremity of the lesion, that is, over the site of the operation. Disinfect the latter. Cast and anæsthetize the horse, and fix him in the lateral position with the poll supported on a pillow formed by a sack of hay. Make a mesial longitudinal incision through the skin and adipose tissue down to the ligamentum nuchæ, a depth of a couple of inches of fibrous tissue being gone through sometimes before the latter is reached.

Cut the cord of the ligamentum at its insertion into the occipital crest. Dissect it backwards as far as it is diseased and then excise it.

The affected part is burrowed by sinuses discoloured and disintegrated.

Having removed every trace of necrotic tissue and opened up every sinus and scraped the bone, if affected with caries, flush out the cavity with an antiseptic solution, swab suspicious parts or the whole of its lining with tincture of iodine, dust it with an antiseptic powder, and arrest the diffuse hæmorrhage by plugging the wound with gauze, cotton-wool, or tow, kept in position by sutures. Remove the dressing next day and treat afterwards as an exposed open wound, irrigating it daily with an antiseptic lotion, and covering it with dry dressing until it becomes lined uniformly by granulations, when the lotion should be discontinued and the antiseptic powder only applied.

Occasionally, owing to the bleeding concealing the field of operation, a portion of necrotic tissue is left *in situ*, so that it may be necessary to cast the patient again in the course of a few days in order to remove it.

When this operative procedure is correctly carried out cure is obtained after a period of four to eight weeks, depending on the size of the wound.

The evidence of pain diminishes and the animal moves the head more freely. Although the funicular portion of the ligamentum nuchæ has been severed and partially excised, the head is held at a higher level after than before the operation, owing to the relief of tension caused by the latter. It has been said that section of this cord causes the head to droop owing to the consequent loss of its automatic supporting effect, but experience proves that this is not the case. Should some necrotic tissue have been left in the sinus, inflammatory symptoms will recur due to the formation of an abscess, requiring renewed intervention to remove the cause of the condition.

A modification of the above method of treatment is to cut a channel through the occiput crest by removing a V-shaped piece of bone therefrom by means of a gouge or fine saw, as recommended by Williams of New York, the object being to permit of drainage over the face. It is not essential to success, and has the disadvantage of wounding the bone and exposing it to infection by the discharge from the lesion.

The use of an autogenous vaccine often has a marked curative effect, and the hypodermic injection of nuclein is reported as having had excellent results in accelerating recovery. The injection of a paste into the sinus, or Carrel's tube treatment of septic wounds by continuous antiseptic irrigations, are methods of treatment which are indicated here as in Fistulous Withers.

The patient should be kept in a hygienic loose-box, and its food should be placed at a convenient level. The hay should not be put in a rack.

After cicatrization of the wound has occurred, the cicatricial contraction may prevent the animal's head reaching the ground to graze. This must be borne in mind when contemplating putting the horse to grass.

J. J. O'C.

SURGICAL DISEASES OF THE URINARY APPARATUS

Anatomy of the Urinary Organs of the Horse.—We propose to preface this article with a few remarks on the structure and positions of the various parts of the urinary apparatus of the horse, followed by a short description of the urine of the different domestic animals. The more important anatomical differences met with in animals other than the horse will be mentioned in due course.

The kidneys, or glands which secrete the urine from the blood, are encased in fat, and situated one on each side of the spine immediately under the loins. The tubes which convey the urine to the bladder are called the ureters. Each ureter leaves a large cavity in the kidney, called the pelvis, at a notch on the inner border of the gland, and passes backward almost in a straight line to enter the upper wall of the bladder near its neck. The openings of the ureters into the bladder are not far apart, and through these openings the urine constantly trickles into the bladder. The latter organ is seldom empty, and, according to the amount of distension, it projects more and more beyond the pelvis into the abdominal cavity. When it is not distended with fluid the urinary bladder lies on the floor of the pelvis beneath the rectum (back bowel) of the male, and the vagina (passage) and uterus of the female. In large animals, therefore, the bladder is easily reached and felt when the hand is introduced into the bowel or passage ; while, in the smaller species, the distended viscus may be manipulated through the lower wall of the abdomen a little in front of the entrance to the pelvis. Lastly, the urethra is the tube, or canal, which conveys the urine from the bladder to the exterior of the body, namely, the extremity of the penis in the male, or the vagina in the female. These four parts comprise the urinary organs—the kidneys, the ureters, the urinary bladder, and the urethra. The **kidneys.** Although the common form of the kidney is such that the expression " kidney-shaped " is in general use, the right and left glands are far from being similar in shape. The right kidney of the horse bears considerable resemblance to the heart on a playing-card, while the left, longer than the right, is more or less bean-shaped. The glands also occupy different positions, the right being situated under the upper part of the last two ribs and the first bone of the loins. The left kidney, on the other hand, lies farther back, nearer the middle of the spine under the last rib and the first two or three loin bones. Except in large horses and cattle, it follows that the left kidney, sometimes termed the " floating kidney," can be readily felt when the arm is inserted to its fullest extent into the rectum. In consequence of its loose attachment this kidney may sometimes be found nearer the pelvis, and in cattle it may be pushed a little to the right side of the spine when the large stomach is distended with food or gas. When enlarged as the result of disease it may be possible to feel both kidneys through the bowel, although the left organ is more easily reached. The structure of both kidneys is the same. Covering the surface is a fibrous capsule which can be stripped off easily in health. If the gland is cut through in a horizontal direction it will be seen to be made up of three distinct areas : (1) the pelvis, or cavity near the notch on the inner border, into which the small tubes of the kidney empty the urine ; (2) a pale-red area surrounding the pelvis ; and (3) a thick dark-red area under the capsule dotted with dark points which are just visible with the aid of a magnifying glass. This dark-red area is very richly supplied with blood, and contains the structures concerned in the secretion of urine. The pelvis may be said to act as a reservoir for the urine ; it is continuous with the ureter, which conducts the fluid to the bladder. The **bladder,** when empty, forms a thick, fleshy, muscular mass which lies on the floor of the pelvis. In this condition in the horse it is about the size of a man's fist. It has been estimated that the distended bladder of the horse is capable of holding nearly a gallon of urine. When full, or nearly so, the organ is ovoid in form with the broad end, or " fundus," directed forwards, while the narrow posterior end, called the neck, is continuous with the urethra. The neck of the bladder is surrounded by muscular fibres which are able to contract and close the outlet for the urine. The expulsion of urine is brought about by the contraction of the muscular wall of the bladder. The **urethra** in the male extends from the neck of the bladder to the free extremity of the penis. It is the common passage for the semen secreted by the testicles as well as for the urine. The first portion of the tube in the horse is only some four or five inches in length, and it lies within the pelvis ; it then turns round the bony arch under the tail at a very acute angle, which not infrequently obstructs the passage of the catheter. The urethra now runs along and within the under portion of the penis, ending in a free projection about an inch long at the end of the penis. The **penis** commences at the bony arch under the tail, passes forward between the thighs, and ends in the expanded extremity known as the glans. The portion in front of the purse (scrotum) can be readily protruded from the sheath (prepuce) in which it is ordinarily lodged. In the horse the glans penis is large, and shaped, during erection, like the rose of a watering-can. At its lowest part there is a deep notch, or groove, in which the urethra projects slightly as a free tube. The **prepuce,** or, as it is commonly termed, the " sheath," is a double fold or turned-in portion of skin, the inner layer of which is reflected on to the penis. It thus forms a tubular cavity for the anterior free portion of the penis. The orifice should be large enough to admit the hand in order to withdraw the penis and cleanse the sheath. When this is the case the horse is able to draw or extrude the penis with ease. Not uncommonly, however, a dirty penis, or a collection of sebaceous material in the prepuce obstructing the urethral opening, sets up irritation and straining, with more or less difficulty in passing urine. Gross neglect may also, in hot weather, lead to the formation of maggots in the prepuce. Nevertheless, a certain amount of dark-coloured, unpleasant-smelling, sebaceous material is quite natural. Being largely composed of fat, it serves the purpose of a lubricant.

The Urine.—The urine secreted by the kidneys varies greatly in health and disease, both in the individual and in animals of different species.

So many diseases of the urinary organs depend for their detection on an examination of the urine that some knowledge of the changes which occur in health is desirable. The variations depend largely upon the nature of the food and the temperature. It is a well-known fact that more urine is secreted at rest than at work; and the quantity is also greater in cold weather than during the warm summer months owing to the increased activity of the skin and the amount of perspiration. A horse receiving an ordinary ration secretes about 8½ pints per day, but this quantity may be considerably increased. The horse's urine is generally thick and turbid, and of a yellowish or yellowish-red colour which assumes a brownish tinge on standing. The urine of a mare in season is distinctly oily. Roughly speaking, urine contains water, urea, colouring matter and mucus, and salts in proportions which are of interest chiefly to the analyst. Quantities of lime and potassium salts are present in the horse, while phosphates abound in the dog and pig. As compared with the horse, the urine of the ox contains more water; it is clear and yellow in colour, and the quantity varies from 10 to 40 pints daily. In vegetable feeders like the horse and ox the reaction is alkaline; in the pig it is either acid or alkaline according to the nature of the food; while the dog's urine is always acid in health, pale-yellow or straw-coloured, and the amount varies from one-half to two pints daily according to the size of the animal and the food. The reaction of the urine is easily tested with ordinary litmus paper. Thus, acid urine turns blue litmus paper red, and alkaline urine turns red litmus paper blue. It is well to remember, however, that urine undergoes rapid changes when exposed to the air, or allowed to decompose either within or without the body. Hence a fresh sample should always be obtained in a clean bottle. Whenever suspicious symptoms of urinary disorder are manifested, the value of making an examination of the urine cannot be too strongly emphasized. Although the analysis must be made by an expert, it may be necessary for the owner or attendant, in the absence of veterinary assistance, to take a sample and forward it to the laboratory. An analysis of the urine is extensively employed in human medicine to establish the existence of certain diseases of the urinary apparatus, in spite of the fact that the patient is able to render considerable assistance by describing his symptoms. The veterinary surgeon has, of course, to rely entirely upon his own powers of observation; and experience has shown that an examination of the urine is the only reliable means of diagnosing kidney trouble. The best method of obtaining urine for this purpose is by passing the catheter.

The Passage of the Catheter.—Catheters are hollow tubes for introduction into the bladder, made either of metal, indiarubber, or other flexible substances. In using the catheter certain precautions require to be observed to avoid injuring the urethra and infecting the bladder, and even the ureters and kidneys; for it is easy to introduce micro-organisms by employing a dirty instrument, or one which has not been properly disinfected. The operation is a simple one, and may have to be performed in an emergency by the attendant on any domestic animal. It is practised in order to empty and wash out a distended bladder; to inject fluids into the urethra; to locate a calculus (stone) or a stricture; or merely to draw off a little urine for the purpose of analysis. In all cases the metal or rubber catheter should be boiled for fifteen minutes before use, the gum-elastic tube being freed from grease and soaked for an hour or two in a strong antiseptic solution, *e.g.* 1 : 20 watery solution of carbolic acid. The penis is drawn out, and, like the hands, washed and disinfected, and a little olive-oil, carbolized vaseline, or boracic ointment is smeared on the instrument. The best lubricant for rubber tubes is known as "K.Y.," and consists of a mixture of gum tragacanth, glycerin, and carbolic acid. For male animals, in which some little difficulty may be met with, the catheter should be flexible, and made sufficiently rigid by the introduction of a cane or whalebone stilette.

For the **Horse,** the tube should be about four feet long and one-third of an inch in diameter. The end which enters the bladder should be solid and provided with one or two lateral openings, while the other end may be expanded to fit the nozzle of a syringe, or furnished with a suitable connection. We have made frequent use of a long human stomach tube, made of rubber, fitted with a funnel of the same material for irrigation purposes. A variety made of plated, spiral steel wire, not unlike ordinary gas tubing, is also employed. The horse is usually in the standing position, the twitch is applied, and the off fore-foot is picked up. Hobbles on the hind pasterns are seldom required. The operator, standing at the right flank, soaps his hand, withdraws the penis, grasps it with a cloth, and gently pushes the instrument onwards until the point reaches the bony arch under the tail and appears quite prominent under the skin. Here the urethra bends round at an acute angle into the pelvis, and offers some resistance to the passage of the catheter. At this stage the stilette is withdrawn several inches, and an assistant presses the point of the instrument round the bend and into the pelvis. The stilette is again pushed home and the bladder is reached. Sometimes the hand is introduced into the emptied rectum in order to guide the catheter, but no force should be employed in pushing the instrument forward. On entering the bladder all resistance is overcome, and a steady flow of urine follows the withdrawal of the stilette.

In the **Ox** the penis is longer and much smaller than in the horse, and the extremity is pointed. Just behind the scrotum nearly one foot of the penis is bent upon itself in the form of the letter S. The double curve, which only disappears during erection, offers a well-nigh impassable barrier to the passage of the catheter, unless it becomes possible to draw out the penis and obliterate the bends in the urethra. The difficulties of the operator are increased by the long narrow prepuce, with its small external opening, through which it is difficult to pass two fingers. Only those who have attempted to seize and draw out the penis can appreciate the obstacles which have to be overcome. The most opportune moment is immediately before, or after, copulation, when the bull's penis may be seized with a cloth and drawn well out, so as to obliterate the curve and enable a catheter of suitable size and length to be introduced. Fortunately, it is seldom necessary to pass the catheter in the ox, for pressure on the distended bladder from the rectum will frequently give relief. Another method, however, can be adopted by the veterinary surgeon. This consists in making an opening into the urethra about a handbreadth behind the scrotum, through which the catheter is easily pushed on into the bladder.

The **Ram's** penis presents the same S-shaped curve, but the urethra projects an inch or more form the free extremity of the penis in the form of a very small, tapering, twisted tube called, from its resemblance to a worm, the "vermiform appendix." In order to pass the catheter the appendix must either be cut off or opened on its under surface. Another method is to incise the urethra behind the curve, as in the ox, but this is more difficult to accomplish in sheep.

In the **Dog** flexible catheters made of rubber or gum-elastic are employed, generally the latter. Sometimes a metal instrument is used for the detection of urethral and bladder calculi. The ordinary gum-elastic human catheter is in general use, especially the smaller sizes one to six; but a large animal like a St. Bernard requires a catheter about eighteen inches long, which is about twice the ordinary length. As a rule the operation is quite simple, if it be borne in mind that the penis of the dog, like that of the cat, is provided with a bone in its anterior portion, which is grooved on its under surface for the lodgment of the urethra. Only small tubes can pass through this bone without difficulty. Just behind the bone there is a large rounded "bulb," behind which the prepuce must be drawn with the finger and thumb. Again, close to the bladder, the urethra is enclosed in a large gland, called the prostate, which is frequently enlarged in old dogs, and offers obstruction to the passage of the catheter, besides interfering with urination. In such cases the finger should be introduced into the rectum to guide the instrument. The animal is placed on his back with his left side towards the operator, who observes the simple precautions already mentioned. If progress is arrested at the bony arch near the tail, the wire stilette with which the instrument is provided is withdrawn a short distance to enable the point to curve round into the pelvis. As soon as the bladder is entered it will be found that all resistance is overcome, and the removal of the wire is followed by a steady flow of urine.

In the male **Cat** the introduction of the catheter—always a difficult matter—can only be accomplished in the following manner: Take the smallest, human, metal catheter, straighten it out, or, better still, use a special, straight, metal instrument of very small dimensions about the diameter of an ordinary probe and six inches in length. A flexible tube is useless. Place the cat in the same position as the dog, or on its left side; extrude and grasp the penis with the left hand, and push the instrument, previously warmed, oiled, and disinfected, perpendicularly downwards towards the bony arch at the entrance to the pelvis. The penis containing the catheter is then slowly bent backwards until the point of the catheter is directed forwards between the thighs, and pushed on into the bladder. In man a curved metal tube is employed; otherwise the procedure is much the same.

In the **Mare,** owing to the short, wide urethra, with its large opening on the floor of the vagina a few inches within the passage, the catheter can be introduced more easily than in any other animal. Two fingers, or more, can be inserted into this opening. Almost any straight, or slightly curved, tube can be passed into the bladder, if care be taken to press it forward along the floor of the passage, and to guide the point into the urethral opening with the finger. The extremity of the tube, which is usually made of metal, is furnished with a rounded " blind " end near which there are one or two lateral openings, or " eyes," for the flow of urine. In the absence of a proper instrument various tubes may be improvised, *e.g.* an elder stem, a piece of lead piping about the diameter of the little finger, the long nozzle of a syringe to which a length of rubber tubing is attached, or any stiff rubber tube of suitable size. But it is not always necessary to pass the catheter in order to empty the bladder or to obtain a sample of urine. Not infrequently the mare and cow can be induced to urinate by merely introducing the finger into the urethra, or by gently rubbing and tickling the skin immediately below the vulva. The latter method is particularly successful in the cow, unless, perchance, the bladder is paralysed. It is scarcely necessary to add that in females, as well as males, the precautions with regard to cleanliness and disinfection should be carefully observed on account of the danger of infecting the bladder and other parts of the urinary apparatus. When the animal, for example the cow, is down and unable to rise, much assistance is obtained by placing a bundle or two of straw under the hind quarters. Raising the hind parts throws the weight forward and reduces the pressure on the hand and instrument. Lastly, the catheter may, if desired, be left in the bladder by tying narrow tape, or strong silk thread, to the rings at the end of the catheter, and fastening the thread or tape to a stitch in the vulva.

In the **Cow** the urethra is longer and much smaller than in the mare, and the somewhat valvular opening barely admits the tip of the forefinger. Just behind the opening there is a short blind pouch, or " cul-de-sac," on the floor of the passage, which must be covered by the finger ; otherwise the point of the catheter is certain to enter the pouch instead of the urethra. Raising the valve with the tip of the finger, the instrument is slipped alongside into the urethral opening. A slightly curved metal tube is generally preferred ; if the point be cut off obliquely it is more easily introduced. The bent double-channelled human uterine tube, known as Fritsch's catheter, makes an excellent cow catheter. We have used this instrument for many years, and have found it easy to introduce, and very suitable for washing out the bladder.

The **Bitch** offers no special difficulty. The urethral opening is situated on the floor of the passage a short distance within the orifice. It is readily located with the tip of the forefinger. If necessary, a wire speculum may be employed to dilate the vulva and expose the opening. Any small sterile tube answers the purpose—for example, stiff rubber with a solid end and a lateral opening or " eye "—but preference is given to a short, curved, metal tube. The bitch may be operated upon standing, or stretched out on a table in an upright position with the limbs secured by means of tape hobbles.

The **Sow** and female **Cat** are catheterized in a similar manner.

In the female cat it is very difficult to find the mouth of the urethra. When found, however, the passage of the catheter presents no difficulty.

In dogs and cats it is often advisable in cases of distended bladder to puncture the bladder through the abdominal wall to afford immediate relief, as in some cases of considerable distension the struggling caused by the passage of the catheter may bring about rupture of the bladder with fatal results.

Retention of Urine.—This is a condition in which urine accumulates in the paralysed bladder to an inordinate extent. Paralysis is the most common cause, as seen in fractures, loss of power in the hind parts, and in milk fever in cows. Yet any obstruction to the outflow of urine may give rise to retention. These impediments take the form of calculi (stones), impacted either in the urethral tube or in the neck of the bladder. Tumours and enlarged glands, like the prostate, may also press upon, and diminish the calibre of, the tube. Sometimes the obstruction affects the free portion of the penis at or near its extremity. In the horse accumulations of sebaceous material in the sheath may block the urethral orifice, while injuries which result in inability to extrude the penis, or to draw it back, may be a cause of retention in any animal.

Symptoms.—All animals strain and make frequent attempts to pass urine, but as a rule they only succeed in passing a few drops, and show evidence of pain during the act. Horses and cattle whisk the tail, paddle with the hind feet, straddle the hind legs, and kick at the belly. Cats and dogs often assume a sitting position, and walk very stiffly with the back arched. In these and other small animals the over-distended bladder may be detected by inserting the finger in the rectum and pressing on the lower part of the abdomen with the other hand.

The bladder feels quite firm, and extends far forward, resting on the floor of the abdomen. The frequent, painful, and more or less fruitless efforts at urination attract attention to the condition, and call for an early and careful examination on the part of the veterinary surgeon with a view to the discovery and removal of the cause. When the hand can be introduced into the rectum, as in horses and cattle, the swollen urinary bladder is at once recognized, and the patient shrinks or groans if pressure is exerted upon it. It is true that in certain forms of "colic," especially those associated with obstruction to the passage of fæces, somewhat similar symptoms of retention may be shown; and the attendant, not unnaturally, thinks that there is "something wrong with the water." But the easy passage of the catheter in such cases proves that no obstruction to the outflow of urine exists, while the emptying of the bladder affords no relief. Nor does the horse affected with colic make such frequent attempts to stale. Yet it must not be supposed that retention is always painful. In milk fever and other nervous affections accompanied by paralysis, the accumulation of urine in the bladder is not accompanied by pain, at least in the early stages. Nevertheless, when urine is allowed to collect for any length of time, the organ is liable to become inflamed, and even ruptured, and a peculiar form of blood-poisoning, the so-called "uræmia" or "uræmic poisoning," may set in rapidly. When this occurs the whole body acquires a urinous odour; there is a high temperature; complete loss of appetite; the patient staggers and looks very miserable; he struggles and becomes unable to rise from loss of power in the hind limbs; and convulsions and stupor set in, followed by death within two or three days. Vomition is generally observed in the dog. Cattle appear to withstand the effects of complete obstruction longer than other animals. Some of our cases have lived until the tenth day, while longer periods have been recorded.

Treatment is necessarily dependent on the cause. First-aid measures consist in giving frequent enemas of warm soapy water, and the application of hot fomentations to the loins, followed by a draught consisting of a pint of linseed oil and one ounce of laudanum for the horse and ox. Plenty of linseed tea should also be given. In these animals the attendant may, by emptying the rectum and pressing on the distended bladder in a careful manner, succeed in bringing about a flow of urine. Yet it is generally necessary, and always advisable, to pass the catheter when possible, both to locate the obstruction and to draw off the urine. While the operation presents no difficulty in paralytic conditions, the instrument may require to be used twice daily until nerve power is restored. The surgical treatment of stone in the bladder and urethra, and of inflammation of the bladder, will be considered later on.

Bloody Urine.—Like retention, the presence of blood in the urine is merely a symptom of a variety of diseases affecting the kidneys, bladder, or urethra. It should not be confounded with hæmoglobinuria (azoturia) of the horse and red-water of cattle, in which diseases the staining of the urine is due to the colouring-matter of the blood, not to the blood itself. When blood is present, no doubt need exist if the urine is set up in a conical vessel; clots of blood then sink to the bottom, and red blood cells are detected with the microscope. Amongst the causes of this condition are: congestion and inflammation of the kidneys and bladder; the presence of calculi in the same situations; and injuries to the bladder and urethra produced by the catheter and in other ways. Poisonous plants, like hellebore, and large doses of turpentine and other irritant drugs, by inducing a congested state of the kidneys, may also lead to blood in the urine. As might be expected, the appearance of the urine will vary according to the amount of blood present and the length of time it has been lying in the urinary passages. Fresh and in small quantity, the urine is stained a bright or smoky red; but the longer it is retained the more chemical change it undergoes and the darker it becomes. It is important to determine, if possible, the source of the hæmorrhage. In the first place, the penis and sheath of the male, and the vaginal passage of the female, should be examined for the presence of tumours, the blood from which is always mixed with the first portion of the urine. If the remainder of the urine be collected it will be found to be perfectly normal. The first portion of the urine is also stained when the blood comes from the urethra, and small clots are frequently passed. Naturally, any fluid or clotted blood which happens to be lying in the urethra is washed out at the commencement of urination. Calculi in the urethra often obstruct the flow of urine, and only a few drops mixed with blood may be passed as the result of frequent straining efforts. But it sometimes happens that the blood is mixed uniformly with the urine, when it comes, as a rule, from the bladder and kidneys; and, again, it is often clotted. From these sources most of the blood may be voided with the last few jets of urine. The presence of clotted blood in the bladder may, in itself, give rise to trouble; for the clots are liable to become arrested in the narrow urethral canal, especially in the bony portion of the dog's penis. Such arrest leads to retention of urine. The same remarks apply to sheep, pigs, and other animals. Finally, according to the cause, the general condition of the patient may or may not be serious. Pain and fever, for example, will be associated with congestion and inflammation of the kidneys.

Treatment.—Calculi require surgical treatment. If the blood is derived from the urethra the catheter should be used with caution in the male owing to the risk of injury. Nevertheless, the surgeon may require to douche the lower urinary passages with astringent solutions such as alum, sulphate of zinc, or adrenalin. Considerable hæmorrhage calls for the administration of drugs, such as ergot and acetate of lead, which tend to stop the flow of blood. Opium (laudanum) also assures to the animal rest and quietness which are essential to the arrest of hæmorrhage, irrespective of its source. While the services of a veterinary surgeon should always be obtained, the patient should be made warm and comfortable, and given a dose of oil and laudanum, as recommended for retention, followed by a linseed mash, and drinks consisting of hay tea, linseed tea, oatmeal gruel, etc. Castor-oil, with a few drops of laudanum, and a milk diet are best for the dog and cat. Needless to say, any food or medicine which may have given rise to irritation should be discontinued.

Urinary Calculi—Stones or Gravel in the Urinary Organs

This condition may affect any animal, but most commonly the ox and sheep, followed closely by the dog. Less often calculi are seen in the horse. The influence of sex and age is of some importance. Although females are often affected, it is well known that stones are much more likely to become arrested in the narrower urinary passages of the male, *e.g.* the bull and ram ; while advancing age favours their formation. The urine of all animals contains a varying percentage of salts in solution, the amount and chemical composition of which depend principally on the character of the food and drinking-water. Under ordinary conditions the salts are excreted with the urine ; but in animals which are improperly fed, or which possess some special or hereditary predisposition, it sometimes happens that the saline ingredients undergo precipitation—that is, they are thrown out of solution—and are deposited in the kidneys and bladder in the form of stone-like masses or concretions, called calculi. The word " calculus " simply means a little stone. The salts, however, are not always formed into calculi. They may form a sandy or gritty deposit, which accumulates in the bladder and passes out with the urine. The gritty sediment, often called " gravel," consists of particles of calcareous material which are, in reality, very small stones. When stones are lodged in the kidneys they are known as renal calculi ; in the bladder, as cystic or vesical calculi; in the urethra, as urethral calculi. Although they may become arrested in the ureters during their passage from the kidneys to the bladder, they never originate in these tubes. Similarly, urethral calculi have their origin, as a rule, in the bladder, from whence they are forced into the urethra with the urine.

The *formation* of the stone, as may be imagined, is a gradual process. The salts, thrown out of solution or suspension in the urine, collect round some nucleus which happens to be present in the urinary passage. By the deposition of successive layers the small stone, or calcareous granule, slowly increases in circumference until the calculus in the kidney or bladder may attain the size of a duck's egg. In the horse, in these situations, they are generally few in number ; indeed, only one large stone may be present, mainly composed of carbonate of lime with a certain proportion of phosphates. The calculi of oxen and sheep have the same chemical composition, but they are often small and numerous. In pigs and dogs phosphatic calculi are more common than other varieties. These salts, it should be remembered, are always present in the urine ; but certain circumstances may arise in which they are deposited in one or more parts of the urinary apparatus.

The *causes* must be looked for in various directions. In the first place, the factors mentioned are undoubtedly of a predisposing or contributory nature, *i.e.* age, individual tendency, and heredity. Females seldom suffer from obstruction on account of the short wide urethra, which permits small calculi to be easily passed. Secondly, the character of the food is a matter of importance ; for feeding experiments show that variations in the quantity and nature of the feeding-stuffs have a decided influence on the formation and chemical composition of the stones. Thus urinary calculi are more often met with in districts where the soil is of a chalky nature. On such land both the crops and the drinking-water are liable to contain excessive quantities of lime, and an increased percentage of lime salts in the blood and urine is the natural result. In the same way cattle and sheep fed on roots and fodder grown with large quantities of artificial manure frequently suffer, as well as animals on grass which has been heavily top-dressed with lime or basic slag. Possibly the relative amounts of drinking-water and succulent food have a direct bearing on the subject. Dry feeding is certainly a predisposing cause in ruminants. But deposition of the salts of the urine is a phenomenon constantly occurring, apart from conditions of soil, from a too generous allowance of nitrogenous food, particularly when accompanied by insufficient exercise, and the indigestion produced by over-feeding. This explains why sheep and lambs, young bulls and heifers, fattened on quantities of dry foods, such as cake, grains, and bran, are specially subject to calcareous deposits. Beets, maize, and other sugary and starchy foods, even turnips, have also been blamed; but the effect of too many turnips is, to say the least, doubtful, unless grown with excessive quantities of artificials. Before leaving the subject of food as a causative factor about which many illogical opinions have been expressed, we would deprecate the common practice of blaming one particular article of diet. Often it is the system of management, or rather the regime, which is at fault, not a certain food. Again, cases of urinary calculi occur independently of the food as the result of inflammatory disease of the urinary organs (see "Inflammation of Kidneys and Bladder"). These diseases lead to pronounced chemical changes in the urine, whereby certain of the dissolved salts are precipitated and formed into stones or gravel. A fruitful cause, in this connection, is retention of urine, which acts in a similar manner.

As in all other diseases, an *accurate diagnosis* is essential. We should know whether stones are present at all, and, if so, where they are situated, and to what extent inflammatory changes have taken place. With the aid of the X-rays it is possible, in dogs and other small creatures, to detect the presence of stone in the kidney; but unless the accumulations reach the bladder, or are passed in the urine, an accurate diagnosis of renal calculi is frequently a matter of great difficulty in horses and cattle. The occasional symptoms which are shown are often obscure, and ascribed to other causes. Why is an accurate diagnosis of urinary calculi so important? It is obvious that early recognition is advantageous for purposes of prevention, which include a change of diet, an abundant supply of pure water, and regular exercise. Again, the patient, when seriously affected, may be promptly destroyed or slaughtered for human food, provided its value does not justify the performance of a surgical operation and the cost of a few weeks' keep. The fact that effective treatment can be adopted in suitable cases before inflammation sets in should also be borne in mind. These considerations should weigh with the stock-owner in seeking expert advice, as soon as the condition is suspected or discovered; or immediately anything is noticed wrong with the " water."

Urinary Calculi in the Horse.—Stones in the kidney, or renal calculi, are comparatively seldom seen in the horse, although they may easily be overlooked. One or both kidneys may contain a single large stone or several smaller stones, without any symptoms being observed during life. It is interesting to note that the same phenomenon occurs in man. According to Rose and Carless,[1] " it is an undoubted fact that stones even of large size may exist for years in the kidney without giving rise to any symptoms whatever." Sometimes the " stones " are present in the form of gravel, when small gritty granules may be found in the urine, or several small calculi may become embedded in the substance of the kidney. But cases are met with in which one large calculus occupies the pelvis of the kidney. Large calculi are always irregular in shape, and assume the form of the cavity in which they lie. Like bladder calculi, they increase in size by gradual deposition of the salts of the urine, until the kidney may become largely absorbed, and little may remain but the capsule or outside covering. In other instances, the constant irritation leads to inflammation of the kidney (see " Nephritis "). As a rule, some of the following symptoms are occasionally shown: colicky pains, especially after exercise or work; tenderness on pressure over the loins; stretching out and straining during repeated attempts to stale; blood in the urine after exertion; stiffness of the loins and hind limbs when made to move; sandy or gritty deposits in the urine, and inflammatory products observed by the microscope; and, lastly, enlargement of the kidney and evidence of pain on introducing the hand far up the bowel. Stone in the kidney may be suspected when gravel and inflammatory products are present in the urine without anything being found wrong with the urethra and bladder. It should be remembered, however, that small stones may be washed into the narrow ureters at intervals, stopping the flow of urine, and causing severe colic; but the obstruction and pain are of a temporary nature. As a rule, small stones readily find their way into the bladder, where they may grow into large calculi.

Treatment is merely palliative, owing to the fact that operations on the horse's kidney are impracticable. Treatment should be carried out on the same lines as in congestion and inflammation of the kidneys, with plenty of fluids, a dessertspoonful of bicarbonate of soda in the drinking-water several times a day, and careful dieting. Chloral hydrate and Indian hemp relieve the pain when colicky symptoms are manifested.

Stone in the Bladder — Vesical Calculus (Horses).—The bladder is the most common situation in the horse. Several small calculi may be found; or, more often, one large stone more or less egg-shaped, and rough or smooth on the surface. In other cases a condition known as "sabulous bladder" is met with in which the calcareous material takes the form of sand or gravel. This deposit is distinctly gritty, and may be seen on the floor of the stable or in the sediment when the urine is collected and allowed to stand. The calculus may be formed in the bladder, or it may be derived from the kidney. Some stones attain the size of a man's fist. As in the kidney, a small stone may not cause much trouble, and its existence may remain unsuspected for years; but larger stones frequently give rise to a very irritable condition of the bladder, of which the almost constant efforts to stale is a prominent symptom. This symptom is more marked in bladder than in urethral calculi. Not uncommonly, inflammation of the bladder is set up, when the symptoms of that condition are observed (see "Cystitis"). The horse walks stiffly, stretches himself out, and may kick at his belly; he looks round to his side, and shows other signs of pain and discomfort. Frequent whisking of the tail is also noticed. Sometimes the urine is passed quite freely until the stone is forced into the neck of the bladder, when the flow is suddenly interrupted. In other instances the urine is continually dribbling away from the penis. Occasionally it is mixed with a little blood. A high colour of the urine with a strong ammoniacal odour is evidence that it has been retained in the bladder for some time. It is often observed that the above symptoms are brought on or aggravated by exercise or work. Sooner or later the general health suffers, and the horse loses condition and strength; he may become much emaciated. The diagnosis of stone in the bladder seldom offers much difficulty. In the gelding and stallion all that is necessary is to empty the rectum and to introduce the well-soaped hand. If the bladder is full, most of the urine should be drawn off with the catheter; when empty, the injection of a quart of fluid assists the detection of the calculus. With a metal catheter the operator may be able to recognize the characteristic metallic click caused by the end of the instrument coming in contact with the hard stone. The sensation imparted by an accumulation of gravel in the bladder resembles that produced by the presence of wet sand in a bag. In the mare the fingers can be pushed into the organ quite easily through the short wide urethra; if the other hand is simultaneously introduced into the bowel, in order to draw the bladder back, the stone is pressed against the finger and readily extracted with forceps. Lastly, in both sexes, reliable evidence can often be obtained by examining the urine.

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[1] *Manual of Surgery*, eighth edition, 1911, p. 1196.

Stone in the Urethra — Urethral Calculus (Horse). — Stones are never arrested in this situation in the mare; but it sometimes happens that small stones pass from the bladder into the long, curved, and comparatively narrow urethral canal of the male, and become impacted at various points. Often the stone is lodged close to the anus, and may be felt as a firm swelling in the middle line along the course of the tube. There may also be a fluctuating swelling above or beyond the stone from the urethra becoming dilated with urine. The passage of the catheter is arrested at this spot, and the metallic click is both heard and felt when a metal instrument, or one with a metal end, is employed. The symptoms, which appear suddenly, as a rule, depend on the amount of interference with the expulsion of urine. If the tube is completely blocked, it is evident that urination will be suspended, and the bladder will become very full and swollen. Unless relieved, the animal's condition rapidly becomes grave, and death may follow from urine (uræmic) poisoning or rupture (see "Retention of Urine"). Fortunately, the obstruction is often only partial, permitting small quantities of urine to be voided. The horse makes frequent painful attempts, but may be unable to pass more than a few drops at a time. Attention is drawn to the case by the pain, scanty urination, and the over-distended bladder on rectal examination. In exceptional instances small stones or gravel are found impacted near the extremity of the penis, which is seized and drawn out as in passing the catheter. An attempt is then made to press the stone towards the orifice of the urethra. Its extraction is assisted by the injection of a little warm olive-oil and the insertion of long, narrow forceps. Sometimes it is necessary for the surgeon to lay open the urethral orifice with the knife, although cutting should be avoided, if possible. Unless a rush of urine follows the removal of the stone, the catheter should be employed to locate other calculi which are probably situated farther up the tube. Collections of sebaceous material and dirt in the horse's sheath may also obstruct the orifice of the urethra; but this is easily remedied by washing out the prepuce with soap and warm water.

Treatment.—Stones in the bladder and urethra usually require a surgical operation for their extraction; hence the owner is advised to consult his veterinary surgeon as soon as suspicious signs make their appearance. In the meantime, he might try copious warm enemas, and gentle pressure on the bladder through the bowel. We have known cases in which these simple measures were successful in moving the obstruction, and permitting a free discharge of urine. It is of course useless to attempt to dissolve the stone. This is a popular fallacy, and medicinal agents administered for this purpose are certain to fail in their object. If possible, the horse should be operated upon in the standing position, for casting entails the risk of rupturing the distended bladder. As a rule, a good sedative or narcotic dose is given, cocaine is injected over the site of operation, the twitch and blinders are applied, and the hind limbs are secured with hobbles similar to those employed for covering mares. Stocks furnish the best means of restraint when available. After bandaging and tying round the tail, the surgeon, with every antiseptic precaution, proceeds to insert the catheter and to cut down upon it over the calculus, when the latter is lodged in the *urethra*. The incision is made exactly in the middle line in the direction of the tube. The stone is then pressed or scooped out, or extracted with forceps, its removal being followed by a rush of urine. The wound is often left unstitched, and merely cleansed and disinfected twice daily for a few days until urine ceases to trickle from it. During this time a little lard should be smeared over the thighs to prevent excoriation of the skin. Healing is generally complete within three weeks.

The operation for *stone in the bladder* is performed in a somewhat similar manner, but the horse is sometimes carefully cast and chloroformed and the rectum is emptied. The passage of the catheter, or the injection of fluid, enables the operator to find the urethra and to open it without difficulty. It also enables him to remove the urine, and to cleanse and disinfect the bladder by the injection of one or two pints of a weak solution of boracic acid, thus moderately distending the organ and lessening the risk of injury from the forceps. The incision down on to the catheter is made close to the anus, and the opening is enlarged in the direction of the bladder as the catheter is partially withdrawn. With one hand in the rectum drawing the bladder back, the fingers of the other hand are introduced as far as possible into the urethra until the stone is felt and extracted with forceps. It may be necessary to crush the stone before its removal can be effected. The operation is simplified by the fact that the distended bladder is close at hand; its neck, as well as the urethra, can also be very considerably dilated with the fingers and forceps. Needless to say, the hand in the rectum is of great assistance in guiding the forceps. It may happen that small calculi can be pressed back into the wound, thus dispensing with the use of instruments. Finally, the bladder is douched with a warm solution of boracic acid, and the wound is treated as before. In the mare, it will be remembered, the urethra opens on the floor of the passage about four inches from the outside, rendering the extraction of the calculus with forceps a simple matter. The knife is seldom required.

Urinary Calculi in the Ox.—Stones in the kidney, although uncommon, are of more frequent occurrence in cattle than in horses. The symptoms and changes are very similar in both species, and further description is therefore unnecessary. As in the horse, no special symptoms of renal calculi may be observed, and their existence is frequently overlooked. The same remarks apply, in the main, to stone in the bladder, the symptoms of which may be more obscure than in the horse. Again, for the anatomical reasons already mentioned, *urethral calculi* only cause obstruction in the male, for the narrow, double-curved tube renders the passage of even small stones difficult or impossible. The bull is generally considered to suffer more than any other animal from urethral calculi, but the ram is also frequently affected. The stones, which are small and numerous, as a rule, are washed from the bladder into the long, small, curved canal called the urethra. They often become impacted, or arrested, in the bent portion of the canal a little behind the scrotum, occasionally near the anus, or the extremity of the penis. Sometimes the salts of the urine, instead of forming stones in the urethra, collect on the long hairs in front of the prepuce, where they crystallize out like sugar-candy on a thread. Cases of this nature are quite familiar to stock-owners in certain districts. The calcareous accumulation is generally white in colour, and tends to block the opening of the sheath, which becomes swollen and inflamed. The sheath soon acquires a strong urinous odour from decomposition of the retained urine. The condition is relieved by clipping the long hairs, opening up the prepuce, if necessary, with the knife, and syringing it repeatedly with a weak antiseptic solution. At the same time, a brisk purgative drench should be administered, *e.g.* one to one and a half pounds of Epsom or Glauber salts, with one pound of treacle, in two quarts of warm water. A change of food is also desirable. As in the horse, the symptoms of urethral calculi are due to interference with the expulsion of urine. The animal becomes uneasy, stamps and paddles with his hind feet, kicks at his belly, and whisks his tail. In severe cases, with complete obstruction, the flow of urine ceases altogether; but, as a rule, a few drops are passed at frequent intervals, with more or less straining and pain. Sometimes a little blood is noticed. While the distended bladder may be recognized by introducing the hand into the rectum, it may be impossible to feel the calculi on account of their small size and the fact that the urethra of the ox is more deeply situated than that of the horse. If the stone completely blocks the canal, the animal's condition rapidly becomes grave; the appetite fails, and the enormously swollen bladder may rupture within twenty-four hours unless relief is afforded. The skin acquires an odour of urine, and, although cattle may live for some time after rupture, there is only one termination.

Treatment.—This should be directed to alleviate the urgent symptoms, and prevent rupture of the bladder, by drawing off the urine. It is seldom possible to pass the catheter in the male in the usual manner (see "Passage of Catheter in Ox"); still, two methods are open to the surgeon. He may either puncture the bladder through the rectum with a long curved trocar and cannula, or the urethra may be laid open close to the anus, as in the horse, and the catheter introduced through the wound. The former method—puncture through the bowel—secures instant relief, and should be practised when early slaughter is contemplated. Slaughter, by the way, is frequently the best and most economic procedure. The latter method—opening the urethra—enables the animal to be fattened, but has the disadvantage of allowing the urine to dribble from the wound, requiring the skin to be smeared with lard. In some cases, however, a cure may be effected by extracting the stone, or stones, through an incision in the urethra a little behind the scrotum. This operation is less likely to be successful when a large number of calculi are present.

Urinary Calculi in Sheep.—Stones in the urinary organs of sheep are chiefly found in the urethral canal of rams. Their presence in other situations appears to have attracted little attention, probably because they frequently give rise to little or no inconvenience. The symptoms of stone in the bladder, when observed, are similar to those seen in cattle and horses. But in the urethra, or, rather, in its extremely small terminal portion called the "vermiform appendix," small calculi sometimes cause fatal obstruction. The chief sufferers are young highly fed rams, especially show animals (see "General Remarks on Urinary Calculi"). On gently turning up the sheep or lamb and drawing out the penis (often partly protruded), it is found that the twisted worm-like tube projecting from the penis is blocked by a sandy or gritty deposit, which is sometimes formed into small calculi. As in cattle, a white crystalline "sugar-candy" powder may close the opening of the sheath. In either event the animal becomes dull and restless, lies a good deal or stands with arched back, breathes quickly, and often strains in fruitless endeavours to urinate. As a rule, only a drop or two of urine is passed at a time. Very soon there is loss of appetite, over-distension of the bladder, and a urinous odour from the skin. Should the "stoppage of the water" have existed for too long a period, the animal's condition becomes very serious, and both the urethral tube and the bladder are found to be much thickened and inflamed. The bladder may be ruptured, as in the ox, with death as the result.

Prevention and Treatment.—Chief attention should be paid to the healthy, or slightly affected, members of the flock, particularly the wethers and rams, all of which have been living under the same artificial conditions. A change of food is always to be recommended. Grains, cake, bran, and similar dry foods, as well as roots grown with quantities of artificials, should be discontinued; and linseed, green stuffs, and other wholesome fodder substituted. Sheep should also be removed from pasture which has been heavily top-dressed with lime or basic slag. As a further preventive, a teaspoonful of baking soda (the bicarbonate) may be given daily in the food, and free access to water should be allowed with plenty of exercise. These measures necessarily interfere with the preparation of the sheep for shows and sales; but a radical alteration in the system of management is required if the disease is to be got rid of. Isolated cases will, of course, call for the exercise of less stringent precautions. Local treatment consists in fomenting the appendix with warm water and gradually pressing out the accumulated deposit. A little warm olive-oil may be injected by means of a syringe fitted with a very fine nozzle; the oil is worked about with the fingers and squeezed out along with the gravel. If necessary, repeat the process and at once administer a dose of salts or castor-oil. A little belladonna, or laudanum, may be added to the oil if there is much straining and pain. The patient should be encouraged to drink, and plenty of fluids (hay and linseed teas, gruels) should be allowed. Sometimes these simple measures fail, or urgent symptoms are shown from the outset, when there need be no hesitation in opening the urethra or appendix on its under surface and in the direction of the tube. The incision should be large enough to permit the stones or gravel to be pressed out. With the same object, the appendix is often cut off, although its removal may render the ram useless for stud purposes. On account of the risk of sterility, opening the tube should first be tried. Unless a rush of urine follows removal of the obstruction, the urethra may have to be opened higher up towards the tail and search made for other stones in this situation; but the operation presents greater difficulties than in the horse and ox. Furthermore, the relief afforded by operations on any part of the tube may be only temporary, seeing that small calculi are always liable to be carried down with the urine from the bladder and cause fresh obstruction. For these reasons, it is generally advisable to kill wethers immediately for the butcher before the flesh becomes tainted with the odour of urine.

Urinary Calculi in Pigs.—Pigs are seldom affected. The causes (see "General Remarks on Urinary Calculi"), symptoms, and treatment do not differ from those described in other animals. Male pigs are more liable to suffer from the effects of gravel than females. Apart from the nature of the food, voluntary retention of urine is probably a common cause in fat pigs, which lie for hours in one position, and appear to be too lazy to rise and make their water. Should certain salts be present in excess in the blood and urine, they show a decided tendency to crystallize out and deposit whenever urine is retained in the bladder. The stones, or gravel, as in other animals, are chiefly arrested in the urethral canal, where they interfere with the passage of urine. Fat pigs should be promptly butchered, unless the deposits can be squeezed out or washed out with the catheter. But the urethral canal may be opened higher up, as described in the horse. Preventive measures include a reduction in the bran and meal ration, and an increased allowance of green stuffs, with quantities of milk, barley water, or linseed. The sharps may be discontinued for a time if no other cause can be discovered. Fat pigs should be forced to take exercise several times a day.

Urinary Calculi in the Dog and Cat.—Stones in the kidneys, or **renal calculi,** are by no means common in the smaller species, although they are more often seen in the dog when the kidneys are examined after death. Old dogs are more frequently affected, not only in the kidneys, but in other parts of the urinary passages, as the bladder and urethra. In many cases no symptoms of renal calculi are manifested during life, or they are so obscure that it is impossible to make an accurate diagnosis. When, however, small stones, or calcareous particles, leave the kidneys, and cause obstruction lower down, more definite and serious symptoms arise. In the kidney, as elsewhere, calculi set up a chronic inflammation and irritation, with chemical changes in the urine, and sometimes a little blood, particularly after exertion and with the last portion of urine. The constant irritation leads to frequent urination in small quantities, or in drops, accompanied by straining, arching of the back, disinclination to move, and stiffness of the loins and hind limbs. When these symptoms happen to be present, the urine should be collected, or drawn off with the catheter, and set up for some hours. Should a calcareous sediment form and nothing be found wrong with the urethra and bladder, an X-ray photograph may reveal the stone in the kidney. As a rule, the stone is large and irregular in shape.

Treatment is mainly directed to relieving pain, increasing the quantity of urine, and regulating the diet (see "Acute and Chronic Nephritis"). Urinary sedatives are sometimes useful, but most attention should be paid to regulating the bowels and exercise, and providing warm dry housing and a milk diet. A little bicarbonate of soda, or acetate of potash, may be given occasionally in the milk or barley water, and plenty of fresh drinking-water should be allowed. These measures will often enable the patient to live in comfort for years, with perhaps occasional relapses of pain. Operations on the kidney are seldom performed in the lower animals; but it is quite possible, as in man, to remove the stone under chloroform, provided the case warrants surgical interference and the difficulties of diagnosis can be overcome. The kidney is reached through an incision in the flank, when it is either cut open and stitched after extracting the stone, or the whole organ is carefully separated from its attachments and removed after ligaturing the blood-vessels.

Stones in the bladder, or **vesical calculi,** are often numerous, small, and approaching the spherical in shape; but one or two large calculi may be present. Although of more common occurrence in old dogs and cats, puppies and kittens are by no means exempt. As in large animals, it sometimes happens that the salts, which crystallize out from the urine, fail to form calculi and are deposited as gritty particles resembling fine gravel or sand. The symptoms resemble those already described; they depend to a great extent on the degree of obstruction to the outflow of urine and upon the inflammatory changes in the bladder (see "Cystitis"). The stones, now and then, cause little discomfort; but, in most cases, the animal becomes restless and uneasy, and strains frequently, passing only a few drops of urine, which may be blood-stained, especially after exercise. When the stone is forced into the neck of the bladder, or into the urethra, the flow of urine may suddenly cease, and the dog shows distinct evidence of pain, becomes feverish, loses his appetite, and suffers in condition. Small, smooth calculi sometimes lie unsuspected in the bladder for a long time, or they may be passed occasionally in the urine, particularly in the form of gravel. With a metal catheter one may succeed in tapping the stone, while the finger in the rectum maintains contact with the distended bladder.

Treatment is necessarily surgical, and consists in the removal of the stone whole or in a broken-up condition. At the same time the general line of treatment laid down for cystitis should be observed. What might be termed the direct method of operation is often resorted to by the surgeon. It is both simple and satisfactory. The male dog, or cat, is prepared, chloroformed, and laid upon its back, when the abdomen is opened on its lower surface in the middle line close to the edge of the bony pelvis, the penis being pushed to one side. The bladder is then drawn into the wound, incised to permit the extraction of the stone, and stitched so as to secure immediate union of the edges and prevent leakage. An alternative method is sometimes practised, in the same way as in the horse, by making an opening in the urethral tube below the anus. Whichever plan is adopted, the bladder is first emptied by means of the catheter, and washed out with a weak solution of boracic acid or other non-irritating disinfectant. A little of this solution is allowed to remain in the bladder to facilitate the removal of the calculus. In the bitch the stone can be withdrawn through the urethra without the use of the knife. It may interest the reader to know that when it is desired to illuminate and observe the interior of the bladder a very neat and useful instrument, called a cystoscope, may be introduced like an ordinary catheter. Fitted with an electric lamp and an arrangement of mirrors, the cystoscope is in daily use in human surgery. An X-ray photograph is often taken in the first instance.

Stones in the urethra, or **urethral calculi,** are quite frequently met with in the male dog. They are derived from the bladder, and pass along the urethra from time to time, with symptoms of pain and more or less obstruction to the expulsion of urine. Sometimes they become impacted in the tube and completely block it. Stones are thus often present in the bladder as well as in the urethra. Large calculi, however, are unable to enter the narrower passage, and remain in the bladder. In the urethral tube the gravel (or stones) tends to become arrested in the narrowest parts, particularly in the bone of the penis, or immediately behind it. Often the calculi are small, numerous, and misshapen from contact with one another. In the male cat, on the other hand, stones are only occasionally seen. Most frequently the cat suffers from a collection of sandy or gravelly material at the extremity of the penis. It follows that the symptoms in these small animals appear suddenly, as a rule, and show a tendency to recur, especially in the case of the dog. The urine is voided with difficulty in drops, or in very small amounts, and there may be a little fluid or clotted blood mixed with the urine. Sometimes the patient suffers acute pain and makes almost constant efforts to urinate. According to the amount of obstruction, the urine retained in the bladder undergoes fermentation, distends the organ, and gives rise to inflammation, urine poisoning, or even, in somewhat rare cases, to rupture of the bladder. Protrusion of the penis is a common symptom in the cat. As a rule, the condition is easily detected, and the calculus located, by introducing a metal catheter and making it strike against the hard object. The end of the instrument, and the stone itself, may be felt under the skin. In some cases it is possible to feel the swollen condition of the urethra behind the calculus, while the swollen bladder can always be detected through the floor of the abdomen and by means of the finger in the rectum.

Treatment is generally operative; yet an attempt should be made with a small probe or catheter to dislodge the stone and enable it to be washed out with the urine. At the same time, gentle pressure should be exerted on the bladder. Manipulation of the end of the penis may succeed in pressing out the gravel which accumulates at this spot in the cat, and even in the dog. Urgent symptoms call for puncture of the bladder through the lower wall of the abdomen by means of a hollow needle, or a special instrument. By thus reducing the pressure of the urine, small stones may be washed out with the next flow. But the operation of opening the urethra is often the only means of giving relief. It is performed in the same manner as in the horse. For the dog a dose of morphia, followed by an injection of cocaine, is safer than chloroform on account of the danger of rupture of the bladder. With the usual precautions (see "Passage of Catheter") the catheter is pushed forward until it meets with the obstruction, and the point can be felt under the skin. The tube of the urethra is then cut in a longitudinal direction, and the stones are removed with a probe, small forceps, or a small spoon. Next, with the aid of a syringe, the bladder and tube are flushed out with a mild disinfectant solution. The wound is frequently left unstitched, and, although a little urine escapes for a few days, healing generally takes place in about a fortnight if the wound is regularly washed and dressed.

A. W.

FRACTURES

Causes.—A fracture is defined as a sudden and violent solution in the continuity of a bone. The immediate causes of a fracture are external violence, some severe force acting from without, or extreme muscular action. The force acting from without may be direct, the fracture occurring at the point of impact, or it may be indirect, in which case the bone is fractured at some distance from the point of impact. The force in this instance has been applied in the long axis of the bone, which is bent beyond its limits of elasticity. It is broken by a twist or bending, and the fracture is oblique or spiral. In fracture by extreme muscular action the bone is broken by a tearing or traction. This is the case in fracture of one or more of the dorsal or lumbar vertebræ seen in broken back, when a horse struggles when cast in the stall or in hobbles.

Classification.—Fractures are classified as simple, compound, and complicated. A simple fracture is one in which there is no communication between the broken bone and external air, and there is no injury to the important structures in the neighbourhood. A compound or open fracture is one in which such a communication exists. This opening furnishes means for the entrance of pyogenic organisms, and adds greatly to the gravity of the injury. It may not be immediate, occurring later from within by the protrusion of some of the fractured parts through the soft structures, or from without by sloughing of the bruised or dead structures surrounding the fracture. A complicated fracture is one that is associated with injury to muscles, blood-vessels, joints, or other structures in the neighbourhood. The fractured bone may sever important blood-vessels and nerves. The force causing the fracture may also cause a dislocation of the joint, and the fracture may extend into it.

Types of Fracture.—A fracture may be a simple fissure or depression, seen occasionally in fractures of the bones of the face. The fracture may be sub-periosteal when the bone is completely broken across, but the periosteum remains intact and prevents displacement of the fractured parts. These fractures are not rare in the tibia of the horse. The fracture may be transverse when due to direct violence, or oblique when the force has been indirect. The fracture is impacted when one fragment is wedged into the substance of the other. A fracture may also occur in which there is no displacement. The bone may be completely broken across, yet the ends remain in apposition. Such fractures, occasionally seen in the pelvis of the horse, are extremely difficult to diagnose.

Displacement of Fractures.—The displacement in a fracture is determined by the direction of the force of injury. It is increased by the contraction of the muscles, and the weight of the limb, when that part of the body is fractured. Transverse fractures with serrated edges are less liable to displacement than oblique ones with smooth surfaces.

Symptoms of a Fracture.—The main symptom of a fracture is loss of function, the injured bone is less capable of bearing weight or acting as a lever. In the case of one of the bones of a limb, there is lameness, acute pain, swelling, unnatural mobility, and deformity of the part when compared with the normal side. Crepitus is the name applied to the peculiar grating sound which sometimes may be both heard and felt when the fractured ends or surfaces are moved the one against the other. The finding of the above symptoms would be sufficient to diagnose a fracture, but the absence of one or more of them would not be sufficient to negative its existence. A horse has occasionally been taken to work with a fracture of the tibia, the lameness at the time being so slight as to be considered of no importance until the fractured bone protruded through the skin. Again, an impacted fracture, or one in which there is no displacement, may exist without any crepitus or increased mobility of the part. When there is little or no displacement deformity may also be absent. Crepitus may be absent in fractures with great displacement, if soft tissues intervene between the fractured parts, or where the broken pieces are drawn apart by the traction of the muscles, as in a fracture of the external angle of the ilium, or point of the elbow. Swelling may be absent in certain fractures. In some fractures of the tibia in the horse, without displacement, the swelling in the early stages is so slight as to be overlooked owing to the resisting character of the periosteum, and strong fascia covering this bone. In examining for fracture it is necessary to be on guard against what is termed "false crepitus," a grating sound, not easily described, heard in deep masses of muscles in which blood has been extravasated, or in which subcutaneous emphysema exists. The swelling in a fracture, except in the case mentioned, comes on rapidly, and is due to displacement of the parts, and effusion of blood into the surrounding tissues. It is always greater in cases due to direct violence, the result of the contusion.

It will be gathered from the above that it is sometimes impossible to secure positive proof that a fracture is present, while on the other hand it is impossible to deny that one is absent.

Treatment of Fractures.—The treatment of a simple fracture consists of reduction, co-aptation, and immobilization. Reduction and co-aptation are brought about by manual dexterity. The fracture is then retained in position by the application of splints made of metal or wood. Other substances are also used for this purpose, such as pitch, starch, and plaster of Paris in the form of bandages. Plastic materials, as mill-board, leather, and poroplastic felt, are also used, and found more satisfactory in certain fractures.

Splints are not always easy to keep in position in animals. When used they should be light, simple, and as free from specialization as possible. In many fractures adhesive bandages or some of the plastic materials will be found more satisfactory than splints. On the other hand, fractures are met with in which it is not possible to apply splints or other retaining materials with any benefit. When it is decided to treat such fractures, it must be on expectant lines with rest and time.

When applying splints, adhesive bandages, or plastic material, all prominences must be specially padded with either tow or cotton-wool, and all hollows filled with the same material, so that the pressure may be equally distributed on the surrounding parts, and support provided against displacement, due to the weight of the limb, muscular action, or the movements of the patient. The parts should be carefully examined daily for the first few days to ascertain that the restraining material and bandages are not too tight and are not interfering with the local circulation.

Treatment of Compound Fractures.—If it is decided to treat a compound fracture, a similar procedure is followed for obtaining immobilization. An attempt should be made to render and keep the wound free from sepsis. Before the retaining appliances are applied the wound must, if necessary, be enlarged, and destroyed soft tissues and all loose pieces of bone be removed. The parts should then be disinfected with pure carbolic acid and the opening packed with suitable antiseptic or sterilized material. A window must be left in the splints and bandages for further dressing.

Repair of Simple Fractures.—In repair of a simple fracture the blood-clot from the torn vessels of the periosteum and the marrow becomes permeated with leucocytes and fibroblasts. A granulation tissue is formed which does not differ from that found in the repair of other tissues except that the fibroblasts, being from cells that normally form bone, become osteoblasts, and proceed to form that material, so that this new fibrous tissue becomes converted into bone. In some instances, especially when the immobilization is not complete, an intermediate stage of cartilage is formed. The newly formed bone is at first arranged in small masses, which, uniting together, form a network of spongy bone. This reparative material of granulation tissue in the process of conversion into bone is called the callus. The external callus surrounds the fragments in a long bone, a similar mass occupying the medullary canal is called the internal callus, while the continuity of the compact bone is maintained by the intermediate callus. Small detached portions of bone may become absorbed or incorporated in the callus, helping to bridge the divided parts. In three or four weeks union is complete; the new bone is soft and spongy, but at the end of six weeks it has become sufficiently dense, in young animals, for splints and other retaining appliances to be dispensed with.

In a compound fracture, provided there is no infection, the process of repair is the same. Should infection occur detached fragments of bone die, a constant discharge of pus is kept up, and when union does take place the succeeding callus is excessive, so much so that it may interfere with the function of the part. When repair is complete the ensheathing as well as the internal callus reduce in size with age, but in the lower animals are very rarely entirely absorbed. The term "vicious union" or "mal-union" is applied to a fracture when its repair is so faulty, owing to excess of callus or overlapping of the fragments, as to cause deformity or loss of function in the part as a weight bearer or as a lever for progression. In certain fractures there may be no attempt at repair by an ensheathing callus. In these cases of non-union the tissue between the fragments may be fibrous, or the fragments themselves may become covered with cartilage surrounded by a capsule forming a false joint. Non-united fractures in the lower animals are nearly always due to local causes. The most frequent are faulty apposition, the presence of muscle, tendon, or fibrous tissue between the fragments.

Prognosis in Fractures.—In arriving at a prognosis many considerations must be kept in view, the age and species of the animal, the service expected of it, and the time and cost of treatment. Whether the animal is kept for the purpose of work, breeding, or fattening will also have to be taken into account. The difficulties in reducing and immobilizing fractures in large animals are obvious. It is also obvious that fractures are less grave and more amenable to treatment in small animals, especially if they are young. The chances of success in treating fractures in small ruminants and dogs is much greater than in the case of horses and cattle.

In certain fractures in some of the large animals, the bony union with time and rest to the part may be complete, but it will be discovered that the callus is so excessive, or the deformity so great, leading to severe and permanent lameness, that the animal is incapable of performing what is required of it. The ensheathing callus is increased and excessive in a comminuted fracture, in any fracture not kept immobile, or in one in which there is imperfect reduction or apposition of the parts. This excessive callus may interfere with the normal movement of the joint, and remain a source of permanent lameness after complete repair of the fracture. Other causes of lameness may be adhesions of some of the soft structures to the callus, or the pressure of the bony material on a nerve.

SPECIAL FRACTURES.—**The Cranium.**—Fractures of the bones of the cranium are chiefly found in the horse. The crest of the occipital bone is fractured by direct violence. In a simple fracture there is great swelling and pain in the region of the poll. Considerable œdema of the head is seen some days after the accident. Compound fractures are more common in this region.

Treatment in a simple fracture consists in keeping the head as much as possible at rest, feeding the animal from a high manger. In the case of a compound fracture the fragments must be removed, provision made for drainage, and the wound treated on the usual lines. Fracture of the occipital at its base is the most serious of cranial fractures and is always fatal. This is caused by the animal falling over on the back of the occiput. The base of the sphenoid may also be fractured at the same time.

The Facial Bones.—Any of the bones of the face, including the nasal bones, may be fractured, generally directly. The common symptoms are pain, swelling, and discharge of blood from the nostrils. In fracture of the facial portion of the frontal bone the prognosis is good. Fracture of the orbital process is more serious, and not always easy of diagnosis. The swelling may be considerable, and the function of the eye interfered with. In a case of a compound fracture any displacement may be reduced by a suitable lever. In a simple fracture over the frontal sinus the depressed bone need not be interfered with, but when the fracture is compound the depressed portions should be elevated and all loose pieces of bone and damaged soft tissue removed. The wound is then treated by the open method.

Fractures of the nasal bones due to direct violence are commonly seen in the horse. Either one or both bones may be fractured. The symptoms are local depression, bleeding from the nose, and if there is considerable depression, some noise will be made in breathing. If the fracture is simple and situated near the nasal peak, the depressed bone may be elevated by a suitable lever introduced up the nostril, care being taken not to injure the turbinated bone. If the fracture is compound this elevation may be made through the wound. In some cases it may be necessary to trephine and raise the depressed pieces, at the same time using every precaution against injury of the turbinated bone.

Fractures of the premaxillary bone are most common in the horse, and are caused by falls and kicks. The fracture may be confined to the external process, sometimes to the alveolar portion involving one or more incisors, or the fracture may be transverse to the body. Diagnosis in these cases is not difficult. Underneath the local swelling the position of the fractured bone can be felt. There is more or less backward movement of the part, and the incisors are generally displaced backwards. In a transverse fracture there is marked deformity, in addition to backward displacement of the incisors. Replacement can generally be effected by hand, although considerable force may be necessary. The fragment may then be fixed in position by wiring the incisors. Sometimes the fracture involving the alveolar portion is an open one, with one or more of the incisors detached. Such cases should have the loose teeth as well as the fractured portion removed. A compound transverse fracture is a more serious matter, and may end in deformity and an excessive callus. Prognosis and treatment should be then carefully considered. Compound superficial fractures in the interdental spaces are occasionally found in young horses when being broken, due to injury from bits. The fractured pieces are slow in exfoliating, and it may be necessary in some cases to remove them surgically. Otherwise these accidents call for no special treatment.

Fractures of the lower jaw are most frequently seen in the horse, sometimes in the dog, in both cases due to external violence, such as kicks and falls. In the horse they are occasionally due to dental operations. I have seen a fracture of the branch near the angle, from an attempt to punch out a diseased molar. Fracture from external causes may occur at the neck, in one or both branches, or at the anterior border. Fractures of the coronoid process are rare. Simple fracture of one branch of the neck of the lower jaw is not always easy of diagnosis, even when complete. There is pain, swelling of the jaw with great difficulty of mastication, but mobility and crepitus may be absent. If the fracture is compound, it renders diagnosis easy, but of course adds to the gravity of the case. In fracture of the body of both branches at the neck, the chin and incisors drop they are mobile, and crepitation can be detected. In the horse subcutaneous fractures of one branch or of the neck unite completely with merely feeding the animal on soft food. Compound fractures are grave, and fracture of the coronoid process much more so. The treatment of double fractures, either at the branches or neck, requires considerable mechanical ingenuity to immobilize the parts and keep them in apposition. Wedge-shaped splints of various materials fitted into the maxillary space are generally recommended. These, carefully padded, are retained in position with suitable straps or tapes, passed over the animal's face and neck. In other cases wiring some of the teeth together with copper wire will keep the parts in apposition. Immediate wiring of the fractured bones may be worth a trial in some cases, especially if the subject be a dog. In compound fractures the wound should be enlarged, if necessary, and all loose tissue, loose teeth, and pieces of bone removed. An attempt must be made to render and keep the wound free from sepsis. The cavity should be disinfected with pure carbolic and the opening packed with suitable material renewed when necessary. Even with the best attention and care suppuration follows, and with it necrosis and sequestra. Then we have, as a termination to the fracture, an excessive callus, and one or more sinuses. Fractures of the lower jaw of the ox are rare, but they are of serious import owing to the anatomical arrangements of the branches at the symphysis.

Fractures of the Vertebræ.—In the horse fractures of the cervical vertebræ occasionally occur from external violence or extreme muscular action. If the phrenic nerve be involved the accident is followed by sudden death. More frequently some of the processes are fractured, leaving the bodies intact. These fractures give rise to regional swelling, pain, and distortion of the neck.

Fracture of the dorsal and lumbar vertebræ is more common, and fracture of the processes of these bones apart from their bodies is rare, except in the region of the withers. These fractures may be caused by collisions, by suddenly stopping, by rearing and jumping, and by kicking—a comminuted fracture of the second lumbar vertebra was found in a riding horse which kicked out with both legs whilst the rider was down tightening the saddle girths—but the most frequent cause is from excessive muscular action when a horse is cast in the stall, or cast for an operation. As the result of casting, any of the lumbar and dorsal vertebræ may be fractured, usually the two last dorsal or the first three lumbar. Fracture is brought about by arching the back, the animal's head is carried towards the sternum, the legs being fixed either against the partition of the stall or in the hobbles. This is followed by a powerful contraction of the longissimus dorsi and the great psoas muscles. The pressure on one or more of the vertebræ in question may be so great as to cause a comminuted fracture of the body of the bone. In some instances this fracture is brought about by lateral flexion of the back and loins, and lifting of the hind quarters clear of the ground. Certain conditions favour these fractures, such as old age, anchylosis, disease of the bone, and the smooth surface on which the animal may be cast favouring flexion of the loins. Want of exercise appears in some cases to favour broken back. Horses which have been rested for lameness, or stallions that have not been used for service and kept at rest for an indefinite period, often break their backs when put down for operation. These accidents generally occur when the animal is laid on its side, rarely when on its back. Fractures of the body of one of the vertebræ in question are generally followed by displacement of the broken fragments and injury to the spinal cord, or hæmorrhage into the spinal canal and paraplegia. If the accident should occur during an operation, a dull snap or crunching may be heard during a violent struggle of the animal, which immediately becomes passive, and begins to sweat on the hind quarters. In other cases the accident is not suspected until the hobbles are removed and the horse is found unable to rise.

In some cases it would appear that separation of the fracture of the body is deferred. In these cases the fracture may only be a fissure. The animal is able, with assistance, to rise and walk some distance with more or less knuckling of the hind fetlocks. Cases are recorded in which animals did work for some time after the injury was inflicted. I have known a hunting horse walk four miles after the third lumbar vertebra was fractured in a jump. Another was ridden a day after such a fracture was inflicted from casting in a stall. With a van mare, which fell on ice, separation of the fracture and paralysis did not occur until nearly a fortnight after the accident, the animal having been kept at rest in the meantime. In cases of broken back, with the exception of the above symptoms, together with loss of sensation in the hind quarters, and flaccidity of the tail, examination gives negative results. Crepitation, swelling, and pain are not observable. When paraplegia is complete the case is hopeless, and the animal should be slaughtered as soon as possible. If the horse be able to stand, it is probable that the vertebra is only fissured, and some slight hope of recovery may be entertained, as we have post-mortem evidence that horses do sometimes recover from a broken back. When the history of the case is obtainable no difficulty is experienced in forming a correct diagnosis of broken back. Where, however, there is no history, and a horse is found with paralysis of the hind quarters, the possibility of other causes such as hæmoglobinuria, sprain of the muscles of the loins, or concussion of the cord should be kept in mind.

Treatment, in case of broken back, must be to keep the animal at rest, if possible, and from lying down until such time as the bony union is likely to be completed. Whether the animal should be placed in slings or not depends on its temperament, and should be left to the discretion of the veterinary surgeon.

Prevention of Broken Back.—A horse should never, if possible, be cast for an operation without a twelve hours' abstention from food. If long out of work it should be exercised to point of fatigue daily for a few days previous, and cast on a soft bed of deep straw. The head and neck should be kept extended when down by capable assistants, lateral flexion should be prevented by an assistant sitting on the upper quarter, and the hobble chain should not be locked too short, so as to diminish as much as possible the " point d'appui " to the limbs.

Fracture of the sacrum is not common. In the horse and cow it is caused by external violence. Compound fractures of the spines of its vertebral segments are prone to be followed by suppuration and burrowing of the pus between the muscular planes of the croup. Fractures of the body lead to paralysis of the tail and rectum, and sometimes paralysis of the hind limbs. Diagnosis is not difficult. The local swelling, paralysis of the parts mentioned, and an examination per rectum are sufficient to satisfy the practitioner as to the existence of the fracture. In cases where paralysis is complete recovery is hopeless.

Fractures of the coccygeal vertebræ are seen mostly in dogs and bovines, and are not infrequently crushed and open fractures. When the first vertebræ are fractured paralysis of the tail results. In the case of simple fracture there is local pain, some swelling, limpness of the tail, and crepitation, which can be felt and sometimes heard.

Fracture of a caudal vertebra frequently terminates in a false joint. In treating such fractures any bandaging to the tail should be carried out with the greatest precaution, as the caudal blood supply is so easily curtailed or arrested that necrosis may occur without precursory symptoms. Compound fractures of the tail are liable to be followed by troublesome abscesses and sinuses, and when possible should be treated by amputation.

Fractures of the Ribs.—Fractures of the ribs are seen in all animals. Simple transverse fractures are most common in horses and cattle as the result of external violence, or sometimes, as in the case of the first rib of the horse, from muscular action. In many cases simple fractures from external violence are incomplete and give rise to no disturbance, and require no further treatment than rest. It is rare that a fracture is limited to one rib, and as a rule the sternal ribs are more liable to fracture than the asternal, which are more mobile. Union is generally associated with a considerable amount of callus, which is found more abundantly on the inner side of the rib. Fracture of the first rib in a horse gives rise to lameness simulating radial paralysis owing to the nerve supply of the muscles of the limb being involved in the injury. There is inability to extend the leg. In instances where the violence is severe and direct, many ribs may be broken and the fragments driven inwards, wounding the pleura, lung, or diaphragm. Then in addition to pain over the seat of fracture, there may be rapid respiration, cough, and a discharge of blood from the nose. Crepitus and mobility of the parts cannot always be detected. In a complicated fracture, involving penetration of the chest, the consequences are much more grave. The injury may be associated with effusion of blood into the pleural cavity, due to rupture of the costal artery ; the ingress of air to the pleural cavity through the wound, or through the lungs from a laceration by a fragment of a rib. Subcutaneous emphysema may also be present, and later traumatic pleurisy, also suppuration of the wound complicated with necrosis of the rib.

Treatment of complicated fractures of the ribs consists in removing foreign bodies and detached fragments of bone, arrest of hæmorrhage, disinfecting the wound, and endeavouring to convert an open fracture into a closed one. Should the pleural cavity not be actually opened, every care must be exercised in the above practice against penetrating into the chest, and every precaution should be adopted to prevent sepsis which may be followed by necrosis and costal fistulæ.

Fractures of the Pelvis.—Fractures of the pelvis are common in horses and cattle due to such external violence as falls on ice and smooth pavements, and to striking against the sides of narrow doorways. The most common and least important of these injuries is the fracture of the external angle. Fracture of the internal angle is occasionally found, but fracture of its shaft is more common, and is an accident of great gravity. The tuberosity of the ischium may be fractured, also the shaft, or the ramus. The pubis may also be fractured through the body or through the ramus. Fractures may also occur through the cotyloid cavity, through the rami of ischium and pubis parallel to the symphysis pubis, or through the pelvic symphysis itself.

Symptoms of pelvic fracture are lameness, which varies greatly in degree, crepitation, mobility, and deformity. In making an examination for a fracture of the pelvis one hand should be placed on the external angle of the ilium, and the other on the tuberosity of the ischium, an attempt being made to move the quarter from side to side. A manual examination can also be made through the rectum, and in the mare and cow, through the vagina. If the animal be down the ear can be placed on the quarter, and at the same time the external angle of the ilium should be moved, or the affected leg put through movements of flexion and abduction. Crepitation is absent in fracture of the angle of the ilium, but can be felt, especially per rectum, when the shaft is broken and the animal is moved slowly. In fractures of the ischium, crepitation can be felt by the rectum or vagina, on movement of the affected limb. With fracture of the cotyloid cavity crepitation can be heard and felt on movement of the quarter or limb. Deformity is most marked in fractures of the ilium. In fractures of its external angle the fragment is drawn forwards and downwards by its muscular attachments. When viewed from behind the angle of the haunch has disappeared, and a flatness can be observed on that side of the quarter. When the shaft is fractured there appears a falling down of the quarter, and some movement and crepitus can be felt between the broken parts when the animal is moved slowly. Fracture of the shaft of the ischium is associated with a flatness of the buttock. A similar flatness is to be observed in the rounded part of the quarter when the ischial tuberosity is broken. Fractures of the pubis or of the cotyloid cavity are not, as a rule, followed by deformity of the quarter. Fractures of the floor of the pelvis may occur without immediate displacement, so adding to the difficulty of diagnosis. In some of these cases œdematous swellings may appear in the region of the udder, scrotum, anus, or vagina, and may assist in forming a diagnosis.

Compound fractures of the external angle of the ilium occasionally occur. These, when neglected, are followed by suppuration and burrowing of the pus between the muscular planes and fascia. In fractures of the shaft of the ilium fragments may injure the iliac vessels, generally the veins, and the animal dies unexpectedly from internal hæmorrhage. The same accident may occur in fracture through the obturator foramen with injury to the obturator vessels. Prognosis in fractures of the iliac angles is favourable. In fractures of the shaft, it will depend on the site of fracture and the amount of displacement. Even in young animals prognosis is bad if the fracture is near the joint with marked displacement. Fractures of the tuberosity of the ischium generally unite with deformity of the quarter; fractures through the shaft are much less favourable. When the body of the pubis is fractured without displacement, union may occur, taking place slowly. It is often imperfect with continued lameness. Fractures through the pelvic symphysis are hopeless. One through the acetabulum is the worst of all pelvic fractures.

In fractures of the angles of the ilium it is sufficient to rest the animal until lameness from the contusion wears off. This applies also to fractures of the tuberosity of the ischium. Other fractures of the pelvis, if treatment be attempted, must have complete rest continued for many weeks.

Fractures of the Scapula.—Fractures of the scapula are not common. They most frequently occur through the spine or the neck, the result of external violence. They rarely occur through the body of the bone.

When the fracture is confined to the body of the scapula diagnosis is difficult, as there is little or no displacement, and crepitation is absent. When the fracture occurs through the neck, in addition to severe lameness, crepitation with increased mobility will be detected on manual examination of the injured part. In fracture of the spine, movable fragments can be detected beneath the swelling. Fractures in this situation are frequently comminuted and open.

A fracture of the body or neck of the scapula can be treated only by rest. No bandage can be adjusted to keep the fragments in position. In a compound fracture of the spine the detached pieces of bone should be removed and an attempt made to render and keep the wound aseptic. Suppuration in this region often extends beneath the fascia.

Fractures of the Humerus.—Fractures of the humerus are found in all animals as the result of external violence, and occasionally, in the horse, of muscular action. The fracture may be through the shaft or through the condyles. As a rule, diagnosis in the former case is easy. Lameness is intense, with extreme flexion of the leg, so that the front of the hoof is in contact with the ground. There is well-marked local swelling, pain, and crepitus on manipulation, with increased mobility of the part. In dogs the fracture often occurs through the condyles, when diagnosis is more difficult. A fracture of the humerus is a grave accident in all animals. In the larger ones treatment offers little prospect of success. If the fracture be transverse without much displacement and the subject young, there is some hope that the animal may be restored to soundness without much deformity of the limb. Such cases are occasionally seen in young cattle and horses. On the other hand, should the fracture be comminuted, impacted, or an oblique fracture with great displacement, healing will terminate with shortening and deformity of the limb, an excessive callus, and permanent lameness.

In a case of fracture of the humerus in a young horse or ox, absolute rest of the injured limb is the only method of treatment, as it is impossible to retain the parts in apposition by any appliances. In certain cases in the horse the animal could be placed in slings with advantage. Young cattle could not be slung, but good recoveries take place in these animals if they are placed in a suitable shed, and kept on short litter, so as not to embarrass the injured limb. In the dog, especially when the fracture is through the lower part of the shaft or condyle, something may be done in the form of retaining bandages to assist union and prevent excessive callus. The materials used should be as light as possible, and should extend from the metacarpus to the highest point attainable above the fracture. If the bandage can be kept in position, it may be removed after a month and the dog allowed exercise.

Fractures of the Ulna.—Fractures of the ulna are generally found in the horse—the result of kicks and falls. The olecranon is broken across, generally into the joint, but occasionally the fracture is confined to the point of this process, and the elbow-joint is not implicated. These fractures are generally difficult of correct diagnosis. There is intense lameness, with extreme flexion of the limb, and local swelling, but crepitation is usually absent as the fragments are drawn asunder by the extensor muscles of the forearm. Hence the difficulty in deciding whether the case is one of fracture of the olecranon, or a severe sprain, or a contusion of the caput muscles.

Muscular action with extreme flexion of the limb renders it impossible to bring together the fragments and retain them in apposition until union is complete. I have never seen a recovery in these cases in the horse. Animals with such fractures were, after many weeks in slings, unable to support weight on the injured limb or to extend it. In the dog, the shaft of the bone is sometimes fractured without implication of the radius. The prognosis in such cases is a little more hopeful. Using the radius as a splint, the limb should be immobilized by a suitable bandage.

Fractures of the Radius.—Fractures of the radius in horses and in cattle occur, as a rule, without fracture of the ulna, but in dogs the violence breaks both bones. In horses, fracture of this bone is generally due to a kick, and may be compound owing to the superficial position of the part. In dogs, the accident is frequently the result of being run over, when the ulna is fractured at the same time.

Diagnosis offers no difficulty except in the case of the dog, when the radius only is fractured—a rare condition.

Fractures of the radius in an aged horse or ox may be considered as incurable. In dogs, foals, and calves, the prognosis is more favourable, especially if the fracture is not near the carpus. Treatment consists in effecting reduction, and maintaining the fragments in apposition by appropriate bandages. In horses and cattle there is considerable difficulty in preventing these from slipping down. A plain bandage applied to the lower part of the radius before the application of the retaining ones prevents this to some extent. Retention bandages of an adhesive character will be found most suitable. They should extend from knee to elbow-joint. A young horse should be placed in slings if possible. The movements of an ox should be limited by a suitable box or shed. In the dog the retention bandage should include both the elbow and the knee joints. Successful union in young horses is always associated with an excessive callus and some deformity of the limb, but such animals have been known to make satisfactory workers for many years.

Fracture of the Carpus.—Fracture of the bones of the carpus is rare in the horse except in the case of severe broken knee. Fracture of the trapezium has been recorded. In both cases correct diagnosis is difficult and prognosis unfavourable.

Fracture of the Metacarpus.—Fracture of the metacarpal bones is seen most frequently in horses and dogs as the result of kicks and blows. Occasionally it occurs in the horse from no apparent cause when the animal is galloped or cantered on soft ground. In the horse the three metacarpal bones are fractured simultaneously, but in the dog the accident may be confined to one bone. It is, however, more common to find several broken as the result of a violent contusion. In such cases the fracture is frequently an open one, or becomes so later from sloughing of the bruised tissues. The diagnosis of a fracture of the cannon bone in a horse is easy. It is more difficult in the case of a dog when one metacarpal bone only is fractured.

Treatment of a simple fracture of the metacarpals in a horse or ox is generally successful, especially if the division is midway in the bone. After reduction, a plaster bandage from the fetlock to the knee joint will be found most effective for retaining the fragments in apposition. After an interval of about six weeks this may be removed. As a rule, no deformity of the leg is observable. It is usually not necessary to place year-old horses in slings during treatment. Older horses may require to be slung. In dogs a plaster bandage is equally effective for retaining the fragments in apposition and limiting movement of the parts. If the fracture is an open one it should be treated "secundum artem." The first essential is removal of all fragments of bone.

Fracture of the Sesamoid.—Fractures of the sesamoid are recorded in the horse whilst galloping. The symptoms are intense lameness, local swelling, pain, and sinking of the fetlock towards the ground. If seen early a crepitation may be detected on movement, and depression felt between the fragments. Correct diagnosis is very difficult, differentiation from injury of the branches of the suspensory ligament being well-nigh impossible. Prognosis is unfavourable, as the means of retaining the fractured parts in apposition and at rest until union is completed are beyond our resources.

Fracture of the Pasterns.—Fractures of the pastern bones are not uncommon in the horse. The causes are false steps, slips, and sometimes direct force. The large one or os suffraginis is the one most commonly broken. The os coronæ is sometimes found broken, the os pedis rarely. The fracture may be longitudinal—"split pastern"—oblique, transverse, or comminuted. Horses used for fast work, particularly racehorses, are usually affected.

The diagnosis of fractured pastern is at times difficult. Severe lameness, suddenly manifested while the animal was in a trot or gallop with subsequent pain and swelling in the region of the pastern, would amount to almost conclusive evidence. In some cases of split pastern there is no displacement, so that crepitus and deformity are absent. In an oblique fracture, or in a comminuted one, both crepitation and increased mobility may be detected. The lameness and swelling at the pastern increase, the latter being of a painful and unyielding character. Fracture of the os coronæ or small pastern bone is brought about by the same causes as those operating in fracture of the os suffraginis, but this bone being partly within the hoof the fracture is more difficult of diagnosis.

Fracture of the Pedal and Navicular Bones.—Fracture of the pedal bone is rare. It has been recorded in horses that have become unnerved. The most common cases are those caused by picked-up nails, and by injury from a nail in shoeing.

Fracture of the navicular bone is commonly associated with navicular disease, especially after neurectomy. It also results from a gathered nail. Fractures of the pedal and navicular bones would be exceedingly difficult of diagnosis unless the fracture were open, and following penetration of a foreign body.

Prognosis in Fractures of the Pastern.—Provided the articular surfaces are not implicated, prognosis is favourable in the case of fracture of the large pastern, although a considerable exostosis may remain. This is voluminous when succeeding a comminuted fracture, and the lameness remains chronic. Complete recovery is rare in fractures of the os coronæ. The succeeding exostosis, partly within the hoof, is always excessive and lameness remains. In fractures of the pedal bone from picked-up nails, or nails in shoeing, the issue is always grave if the fragments are not discovered and removed early. In fracture of the navicular bone no recovery can be expected.

Treatment of fractures of the pastern bones consists in a long period of absolute rest. A plaster bandage may be applied, extending from the coronet to above the fetlock joint. The hollow of the heel must first be well padded, so that pressure may be evenly distributed on the injured and adjoining parts. Slings may be dispensed with. The animal should be encouraged to lie down frequently on a bed of sawdust or similar short material. Straw embarrasses the leg and frequently gives rise to bedsores. When the fracture is through the os coronæ, a retaining bandage is of no assistance. Prolonged rest is all that is necessary to assist union of the broken parts.

Fractures of the Femur.—Fractures of the femur due to external violence occur in all animals. In the horse this fracture is usually due to a fall or muscular action when the animal is cast in hobbles for an operation. The fracture may occur through the neck, but fracture of the shaft is more frequent. Fractures of the trochanters are recorded.

Diagnosis of fracture of the femur through the shaft offers no difficulty. The symptoms in the horse are extreme lameness, shortening of the limb, marked local swelling, intense pain on movement of the part, and increased mobility. If the animal is down it will probably be unable to rise without assistance, and then only when turned on the sound side. Crepitation may be absent or not well marked. If there is much displacement of the fragments it may be entirely absent. In cases of a fracture through the neck some difficulty may be experienced in arriving at a conclusion as to whether fracture exists or not. The history of the case, and the increasing local swelling with marked shortening of the limb, assist in arriving at a diagnosis. Fractures through the trochanters and condyles are also difficult of correct diagnosis, though they may be guessed at. The only symptoms are lameness, local pain, and swelling. The contraction of the attached muscles draws the fragments apart, so that crepitus is absent. Fractures of the femur are of grave import in all animals, more particularly in the horse and ox. In these animals repair is incomplete, leaving shortening of the limb, excessive callus, and permanent lameness. Recorded cases of complete union of fracture of the femur in the horse with soundness and full capacity for work should be received with caution. Such statements are frequently based on wrong diagnosis.

In small animals, including dogs, the prognosis is more hopeful, but much depends on the amount of displacement of the fractured parts. If slight, the succeeding shortening of the limb and the ensheathing callus will be less marked, and the animal may in time walk practically sound. On the other hand, if the amount of displacement be great, the succeeding callus will be excessive. Also, masses of muscle may be interposed between the fragments, and the formation of the callus prevented. In such instances, marked deformity of the limb and lameness will remain. If it be decided to treat a case of fracture of the femur in a horse or ox, complete rest is the only course to be adopted. Any attempts to reduce the fracture are to be deprecated, as it is impossible to overcome, or successfully oppose, the great resistance of the muscles of the quarter and thigh. Even in small animals attempts at reduction of the fracture frequently fail and do great harm. If successful, it is most difficult to maintain by any method of bandaging or appliance, owing to the powerful muscular contraction, and the subsequent movements of the animal. It is therefore, under such circumstances, better to aim at keeping the fractured parts in apposition, without reduction, and at rest, with an appropriate retention bandage applied from the point of the hock to a point as high up the thigh as possible. The difficulty is to prevent such a bandage slipping down. This can to some extent be prevented by using one made of some adhesive material, carrying it over the quarter, and taking it round the opposite leg. In many instances these bandages have small effect on the union of the fracture, and add only to the discomfort of the animal, especially if the injury be towards the upper part of the femur. Then it is better to treat the case on expectant lines without bandages.

Fracture of the Tibia.—Fractures of the tibia are seen in all animals, and are common in the horse. They are due to external violence—direct, in the form of kicks to the inner surface of the limb; indirect, from slipping on ice and smooth pavements, and in going at a fast pace over uneven ground. The fracture may be simple, compound, or complicated, with or without displacement. In the horse the fracture is frequently a compound one. The wound communicating with the fracture may have been inflicted synchronously, or the fragments may, by subsequent movement, have been forced through the soft structures. Fracture without displacement is peculiar to and not infrequent in the horse. In this case the bone may at first only be fissured. Fracture is completed and displacement brought about later by the act of rising or lying down, or by movements performed by the animal during ordinary work. On the other hand, fracture may have been complete from the outset, the strong periosteum and fascia peculiar to this part preventing any displacement for a time. When the resisting character of these tissues is weakened by the subsequent inflammatory process, separation of the fragments follows. In many recorded cases the associated lameness was either absent, or was so slight that the injured animal was at work some days after the injury, before displacement occurred. No definite time-limit can be given when, after such injury, displacement may occur. Not many days is the rule, but instances have been given in which displacement has been delayed some weeks.

Fractures of the tibia with displacement present no difficulty in diagnosis. Extreme lameness, the pendulous limb, the evidence of pain and crepitation on manual examination of the injured part are so pronounced that error is impossible. But in cases without displacement considerable difficulty will be experienced in deciding whether fracture exists or not. Lameness, and pain on pressing the injured part, are the only symptoms present. The local swelling is often negligible, owing to the resisting character of the subcutaneous tissue covering the inner surface of the tibia. In such cases it is best to express no immediate opinion as to existence or non-existence of fracture. In the horse, fracture of the tibia with displacement is hopeless. When displacement has not occurred there may be some slight chance of recovery if the fracture be partial, or the fissure of small extent. The horse must be given absolute rest, as soon as lameness is discerned and localized in the tibia. Every case of lameness in the tibia of the horse should be treated as a fracture. The animal must be placed in slings or tied up short for three weeks. No effective support can be obtained from retaining bandages applied to the leg, owing to the impossibility of obtaining uniform pressure over and about the injured part, and of preventing the bandages from slipping down. It would appear that in certain cases where the tibia is fissured, there is no attempt at repair. A five-year-old cart mare, found dead lame from no apparent cause, evinced pain on pressure of the inner and upper part of the tibia. The animal was kept at rest in slings for two months without benefit. On post-mortem, a fissure was discovered six inches in length and three-quarters of an inch deep, extending into the joint in the fossa of the internal meniscus. There was considerable thickening of the adjacent periosteum, but no evidence of repair of the fracture could be detected. Sometimes after an animal has been treated on the above lines for suspected fracture of the tibia, an exostosis may be discovered on the inner surface of the leg. This cannot be treated as conclusive evidence of previous fracture, as in severe contusions of the periosteum the exudate frequently becomes ossified.

In foals a simple fracture with displacement may be treated with a fair amount of success, especially if the injury be towards the inferior part of the shaft. Treatment consists of a pitch retention bandage and limited exercise. There is always a certain amount of deformity in the limb afterwards. In cattle and dogs, fractures of the tibia generally unite in the course of a month. Retention bandages are generally applied to the injured leg. Their utility is questionable, as complete and satisfactory union of the fracture takes place in both animals without their aid, if the patient be confined to a limited space.

The treatment of compound fractures of the tibia is hopeless in any animal except the dog. Even in this animal, when the fracture has been seen early, and before serious wound contamination has occurred, prognosis should be guarded.

Fractures of the Bones of the Hock.—Fractures are rare and may be looked upon as incurable in horses and cattle. In a fracture of the os calcis there would be extreme lameness, flexion of the joint, and local swelling, with a flaccid condition of the tendo Achillis. Fracture of the astragalus, or of any bone of the hock, would be difficult to detect without a communicating wound, and any opinion as to its existence would be conjectural except in the case of compound fracture.

Fracture of the Metatarsus.—What has already been said respecting fractures of the metacarpal bones and the anterior digits applies to corresponding bones of the hind limb, with the reservation, that fractures are of more serious import in the hind limbs than in the fore ones.

R. J. H.

RESTRAINT

Methods of Controlling and Securing the Horse.—The means by which horses may be restrained and made amenable to operations and the administration of medicines must depend upon a number of factors, especially the age, breed of horse, and the particular operation it is intended to perform.

No hard and fast rules can be laid down. As much will depend upon the skill, tact, and judgment of the operator himself as on the individual peculiarities of the horse to be operated upon. What is a successful method in the hands of one man may be a disastrous failure in the hands of another.

Horses differ a great deal in temperament. Some nervous, excitable horses will require patience and kindness rather than rough usage; others, again, will not respond to caresses, but are quickly cowed by a suitable method of restraint; *e.g.* some well-bred, excitable horses will resist violently even if a twitch is applied, but will stand quietly and submit to operation when it is removed and their fears are allayed by kindness. For some a general anæsthetic is the only safe method of restraint, and it is the close observer of the temperament and habits of the horse who will choose the most suitable one.

It is the object of the author of these notes not to describe every appliance, but chiefly those which he has found to be most serviceable under the different conditions met with in a busy practice.

It is always advisable, however, to try benign methods first; if these fail more drastic applications must be used; but whatever method is adopted one must consider not only the safety of the operator and his assistants, but also that of the animal. For minor operations it is not usually necessary to cast the animal, and there are many appliances which can be used for the purpose of control.

The head must always be secured either by a halter, head-stall, or bridle, and a bridle with blinkers is always to be advised.

It will be found of great advantage to pass the halter-rope twice through a ring or round a post; there is then no fear of the attendant being injured by the fore feet, and if knee-caps are applied the horse will not hurt himself. The ring for this purpose should be on a level with the head, so that the fore legs cannot get over the rope during struggling. If the ceiling of the building is fairly low a ring may be put in it and the head pulled up tight. This answers very well indeed for horses that rear or kick when being clipped.

For operations on young foals, *e.g.* docking, it is usually sufficient to pull them up to a ring in the manger and hold them securely pressed against the wall. The halter should always be hitched before this is done, otherwise the lower jaw may be injured, and the rope must never be tied.

For operations on the nose and teeth two halters may be applied, one in a reverse manner. The horse having been backed into a stall, the ropes are put around a stall-post or through a ring on each side and held by two men. A strong head-collar with two ropes answers the same purpose. Other restraining appliances for the head include: (1) Twitches; (2) Gags; (3) Blinders, Bluffs, and Blinkers; (4) Side-rod and Cradle; (5) Cross-reins.

(1) *Twitches* are of various kinds; some are called humane, but all operate by bringing pressure on the nerves, so taking the attention of the animal from the part operated upon.

They may be described as necessary evils, and although some humanitarians consider them to be barbarous instruments of torture, it is quite impossible to control some animals without them. They should, however, only be resorted to when absolutely necessary.

The commonest form of twitch consists of a strong piece of soft rope, preferably of cotton or hemp, in the form of a loop attached to a strong round pole, varying in length from 1 to 5 feet.

The twitch may be applied to the upper or lower lip or to the ear, but if to the latter a piece of hair should be included, and it should be put well over the base of the ear. Care should be taken not to use too much force, otherwise the muscles of the ear may be torn. Sometimes the loop is placed round the lower jaw, but this method is rather dangerous; it may cause the mouth to be cut, and is not to be advised unless it is impossible to place it on the upper lip or ear, either through injury to these parts or viciousness.

A so-called *humane twitch* is made of two pieces of grooved wood hinged at one end. The upper lip is included and fastened in that position by means of a strap. It is too short to hold with any advantage, easily slips off, and is useless for many purposes. It has the advantage when the operation is being performed single-handed that it may be left in position and needs no one to hold it. It is also useful when casting animals.

A short twitch about one foot long may be utilized for the same purpose by tying it to the head-stall with a piece of cord.

(2) *Gags.*—Various gags have been invented by experts in the breaking of horses, *e.g.* Galvayne, but most of them operate by pulling the corners of the mouth upwards and by compressing the head.

A halter can easily be made into a gag in cases of emergency by removing the rope from under the jaw, placing it in the mouth and pulling it as tightly as necessary. Sometimes a loop of the halter shank is placed round the lower jaw. Care should be taken not to include the tongue, as it is not at all rare for that organ to be severed or very badly injured in this way.

This method is not to be advised. A better way is to make a running loop low down on the nose so as to compress the false nostril and nasal peak (Fig. 200). This is usually effective.

The Polish gag acts on the same principle as a tourniquet. A loop of rope is put in the mouth and carried over the head; by means of a piece of stick it is tightened up as may be necessary.

(3) *Blinders, bluffs, and blinkers* are usually made of leather or partly of canvas and leather, and are strapped over the head, so as to restrict the vision of the animal. Some horses thus blinded are rendered perfectly docile, but this is not always the case, as the following thrilling experience of the author will show:

A thoroughbred colt was being prepared for operation, but as soon as blindfolded he seemed to lose all sense of reason, rushed madly round the box, and finally plunged head first at the wall, which fortunately was old and made of wood, and fell through on the other side. Since this experience the author has preferred the use of blinkers, unless the animal is securely fastened by the head.

Blinkers have the advantage of preventing the horse seeing what is going on behind without causing alarm, at the same time allowing him to see where he is and where he is going. They might be more often used with advantage. An ordinary harness bridle answers very well.

For stallions blinders or bluffs are most useful and necessary when they are obliged to mix with other horses; *e.g.* at shows, or when travelling. These are usually made of canvas, and some of them just fit over and cover the eyes.

(4) *Side-rod.*—This is a round wooden pole or rod, provided with a leather strap at each end, one of which is buckled on the head-stall and the other on the surcingle or roller. It is especially useful for stallions that have a habit of biting, for horses that tear their rugs, and sometimes to control a vicious animal during minor operations.

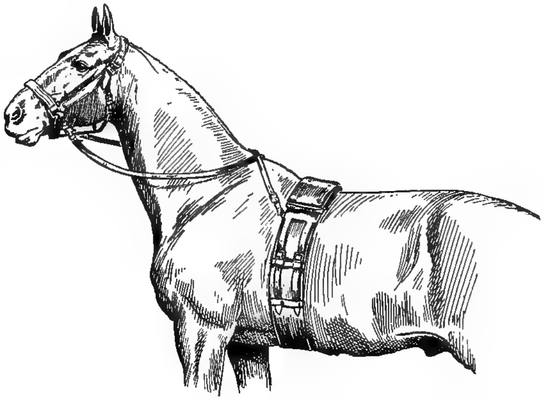


FIG. 192.—Cross-reins.

The cradle is an appliance put round the neck. It consists of a number of parallel wooden rods with rounded ends, strapped together by two bands of leather in a circular manner and fastened round the neck. It is made in various sizes, and is useful to prevent animals biting their legs after firing or blistering. It should always be made to fit, for if it is too small or too loose it is of no use, and if too large it may cause injury to the animal. Nervous horses will sometimes throw themselves down when it is applied, and it may get caught on a projection in the stable. A much more effective appliance is—

(5) *Cross-reins.*—Two reins crossing over the neck are fastened to the head-stall and the roller or surcingle of the animal, so that he is quite unable to get his head down to the fore

legs, or turn it to bite the hind ones. It causes very little discomfort, does not chafe the neck, and can be adjusted easily to fit any size of horse.

Securing one or more Legs.—This makes it more difficult for a horse to kick, though it does not absolutely prevent him from doing so on occasion.

If a fore leg is held up it should be on the side on which is the operator, and to secure it in that position a knee-band may be applied. This consists of a leather strap with two loops and a buckle and is strapped tightly round the forearm and pastern. A stirrup leather answers the purpose very well, or a rope may be fastened round the pastern, the loose end being brought over the withers, to be held there by an assistant. Knee-caps should always be worn, and there should be a soft bed of straw.

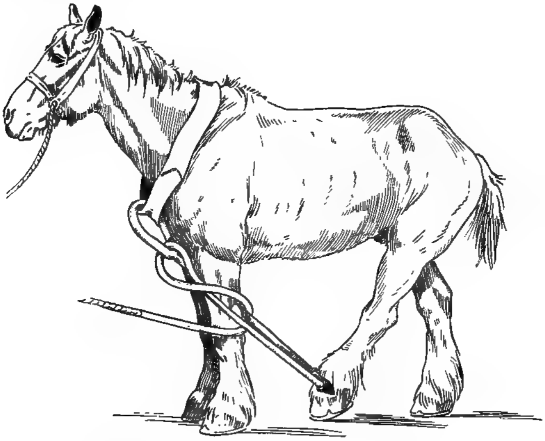


Fig. 193.—Single side-line applied.

For operations on the hind leg—*e.g.* firing curbs, back tendons, etc., or even for firing the fore legs—a most effective apparatus is the *single side-line.* There are several kinds, but most of them consist of a collar piece round the neck and a rope which is attached to a hind limb. This is pulled forwards so that all the weight rests on the other hind leg.

Probably the best form of side-line and method of fixing is the following: It consists of a strong leather collar-piece (shaped like a false collar) to which a rope is fixed with a loop at the point of attachment. The rope is covered with leather to make it stronger and run easier. A leather heel-piece with two iron D's is put round the pastern, and the rope threaded through after passing between the fore legs. The rope is passed round the outside of the fore leg through the loop near the collar, then back, and over the two ropes behind the fore leg so as completely to encircle it. The hind limb thus hobbled is pulled forward so that the *point of the toe only* lightly touches the ground. The horse can thus balance himself, but cannot put any weight on the leg to enable him to kick with the free leg or to rear. The other hind leg can be operated upon with ease, as can also the fore leg.

The author has fired hundreds of horses of all breeds with perfect safety by this means, so long as the rope is held by a reliable assistant.

If the side-line described is not at hand, one can be made by means of a stout piece of webbing or cotton rope with a padded loop at one end to go round the pastern, or a hobble strap with two D's through which the rope can pass, so as not to injure the skin of the heel.

The hobble or loop is put round the hind pastern, and the loose end of the rope may be passed through an ordinary harness collar round the neck, or through a surcingle round the body. The leg can thus be pulled forwards and upwards by taking a turn of the rope round the fixed part.

Another method is to pass the loose end between the fore legs, round the shoulder over the withers, and down again, making a fold round the other part of the rope near the elbow.

Sometimes it is necessary to fix a hind limb in a backward direction; *e.g.* in shoeing a kicker.

One end of the side line is applied round the neck to form a collar, and fastened there while the loose end is passed round the pastern, or through a hobble placed on the hind leg to be secured. By the aid of an assistant the leg is pulled backwards, while another assistant seizes the foot, resting it on his leg as in the manner for shoeing. This is a very useful method for some horses, but others will struggle violently until released, or until they throw themselves down, so that great care has to be exercised.

A modification of this method is to carry the rope from the neck along the back, making a loop round the base of the tail and so down to the pastern.

The disadvantage of this procedure is that the animal in his attempts to struggle makes the tail sore, and with some horses it creates a tendency to kick.

Securing both Hind Legs.—Sometimes it is necessary to hobble both hind legs for operations such as docking, or to prevent injury to the stallion when serving the mare. For this purpose may be used:

(*a*) *The covering Hobbles.*—The commonest kind of hobble is made of two ropes with loops at one end padded with soft leather or felt to go round each pastern. They are then twisted up tightly to prevent much lateral movement, brought between the fore legs, and tied round the neck. One rope is usually made longer than the other, and has a felt pad to go over the withers to prevent injury there.

(*b*) The ordinary casting hobbles may be utilized. Two are placed on the hind pasterns and the rope and chain passed through each, then between the fore legs, round the shoulder, over the withers, and looped over the fixed part, being held forwards by an assistant.

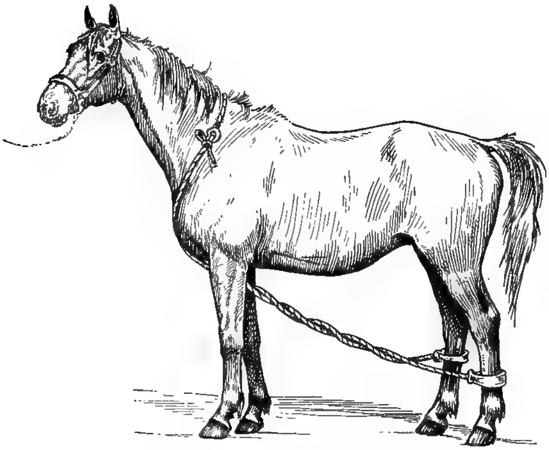


FIG. 194.—English covering hobbles.

Stocks or Trevis.—In America, and to a less extent in England, these are commonly used to control animals when other methods have failed. They are especially useful to shoe unruly horses or mules. There are many kinds, but all are fixtures made of wood built into the ground. The object is to control as far as possible the animal's movements and at the same time to prevent injury to the operator. They consist of four posts let well down into the ground and cemented there; two or more cross-pieces at each side and at each end; a sling to go under the body to prevent lying down, and some arrangement to enable a hind leg to be pulled up and secured in whatever position is required.

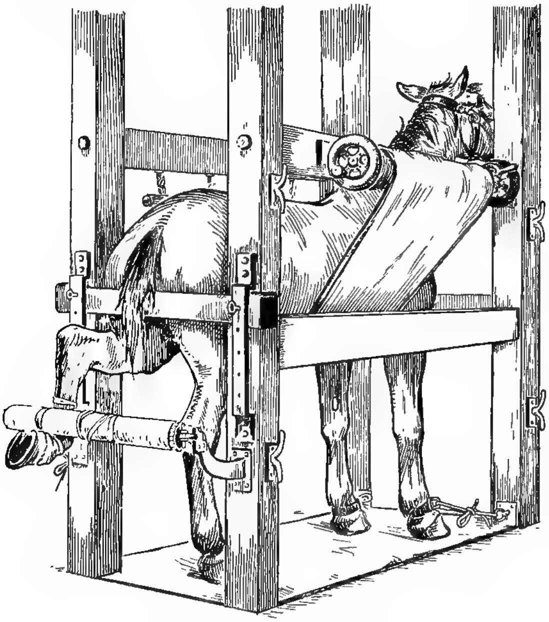


FIG. 195.—Stocks for horse.

Sometimes also there are iron rings in the floor with which to attach the feet. Beams are sometimes put above to prevent rearing, or plunging out of the stocks.

The disadvantages of stocks are:

(1) They are unmovable and not at hand when wanted.

(2) It takes some considerable time to fix the animal.

(3) They must be made of very strong material, otherwise they are easily broken.

(4) Some animals are difficult to get in, and when fixed plunge and struggle most violently, sometimes to their injury.

The advantages claimed are:

(1) The animals cannot kick the operator.

(2) There is not the danger of casting, and for old animals with anchylosis of the spine casting is a serious consideration.

(3) The operation can be more readily performed while standing; *e.g.* shoeing.

(4) After being put in the stocks several times, the animal will often submit to being shod without them.

Improved Stocks.—One of the best stocks is an American invention. It can be fixed in a forge or stable, and when not in use may be folded up flat against the wall, so economizing space.

It is made of two parallel pieces fastened at the side of the building by means of hinges or stout posts let into the wall. Fixed to the side-pieces is an appliance to grasp the pastern, lift it up, and fix it in whatever position is most desirable.

The horse can be walked in as into a stall, and the side-pieces, operating on hinges, can then be adjusted, and a belly-band working on a crank fixed underneath.

Major Abson, A.V.C., has had one of these stocks now for sixteen years, and speaks in very high terms of its efficiency. Although it is in frequent use he has never had a horse injured, and in all that period has only once had to renew the canvas part which goes under the belly.

CASTING.—Many operations can only be performed in the recumbent position, and for the sake of the patient and operator it is necessary to cast the animal. If this is carefully and skilfully done the risk of an accident is very small, but it should never be undertaken without using every precaution to avoid injury, especially if the horse is a very valuable one, is old, very nervous, or strong-willed.

In many cases it will be found advisable to administer an anæsthetic previous to casting, and the author has no hesitation in strongly recommending this practice, having used it for a number of years with success. It not only reduces the risk of accidents to a minimum, but also facilitates the operation itself, and is more humane for the animal. As there is very little struggling fewer assistants are required to cast and hold the animal, which is a great consideration when operations have to be performed in the country, where skilled men are not often available.

Chloroform is the best anæsthetic, but narcotics may be administered about an hour before the horse is cast.

Chloral hydrate in doses of from one to two ounces dissolved in from one to two pints of water given by the mouth or rectum answers very well, or the drug may be given in the form of a ball. *Cannabis indica* is sometimes used, and also morphia, but the latter is not so effective for horses as for dogs and human beings. Five to ten grains, according to the size of the horse and the degree of narcosis required, is administered hypodermically. If larger doses are given excitement and delirium often result, also the horse sweats freely, which is objectionable for some operations, *e.g.* clipping.

A method will be described later for administering chloroform standing.

Precautions to be adopted previous to Casting.—(1) A soft bed of straw, sawdust, or tan to break the fall, and if these are not available a grass plot or soft ground well covered with grass.

(2) Capable and sufficient assistance. Usually four to six men or more are required, according to the temperament and size of the horse.

(3) Instructions should be clearly given to each man beforehand exactly what he should do.

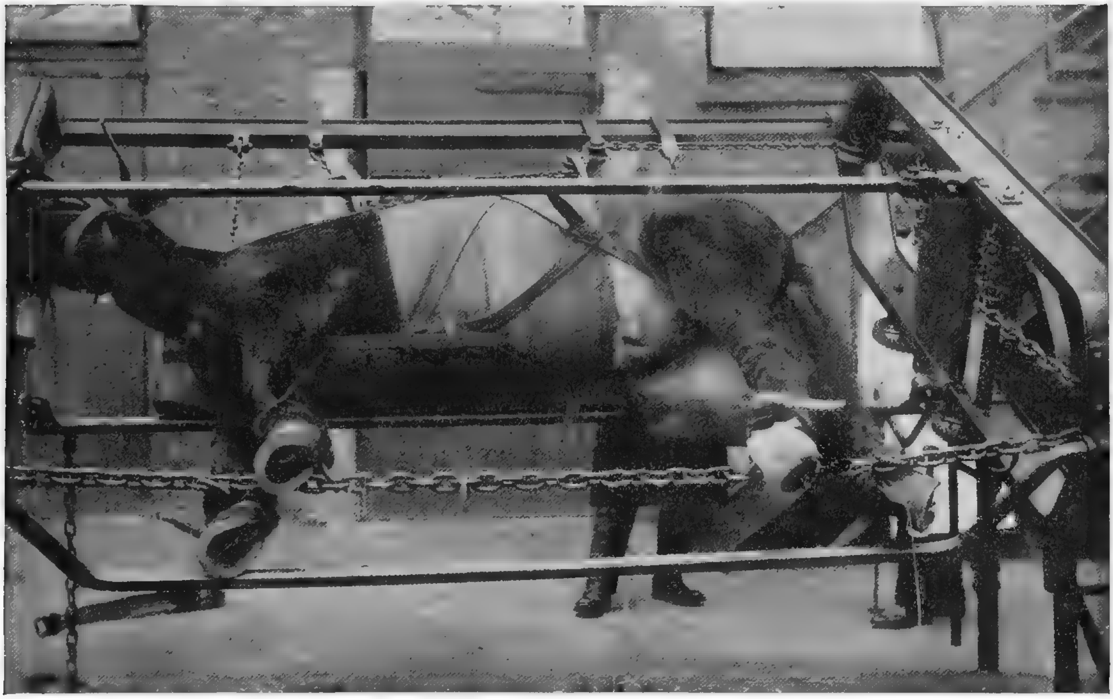


FIG. 196.—Horse secured in operation table.

(4) The appliances should be sufficiently strong and in good order.

(5) The head of the horse should be secured by a halter which cannot slip off, or preferably a bridle. A short twitch may also be applied, and blinkers or blinders put over the head to restrict the vision.

(6) The animal should be fasted for at least twelve hours previous to operation, to lessen the risk of a ruptured stomach.

Apparatus.—Innumerable appliances have been used for casting, but it is not my intention to describe them all here; it will be sufficient to give those that are most commonly in use, or have proved most serviceable and safe.

For young animals the simplest apparatus is the casting rope or double side-line, and this is generally used for operations on the under part of the abdomen, such as castration, operations for herniæ, etc.

An ordinary waggon rope answers the purpose very well, although special cotton ropes can be obtained with a leather neck-piece having a buckle so that it can be strapped round the neck, and made to fit any size of horse. If an ordinary long rope is used it is doubled in the middle and a loop is made to fit the neck, while the two ends are brought between the fore legs, one being placed round each hind heel from without to within and so to the collar on each side. Some operators prefer the knot to be on the top of the withers, in which case the ropes will not pass between the fore legs.

It is a distinct advantage to use in addition a surcingle with an iron D at each side, round the body, or a strong hemp rope. This rope should have two round eyelet holes let into it, and a short piece at the withers to attach it to the neck rope, so preventing it from slipping over the head during the struggles of the animal, which not unfrequently happens with small thoroughbred colts. The colt may be held by an assistant, or the halter shank may be folded round a post, taking care not to fasten it.

Two men are usually required on each rope, and the colt is cast on the off side first as a rule. The men on the near rope pull forwards, and those on the off rope sideways and backwards. When down, the hind leg is firmly secured by a double hitch, and after running the end through a ring in the surcingle or body rope the fore leg is secured in a like manner.

The colt is then rolled over and the upper legs also fastened, when the operation can be performed.

A back rope fixed to one hind shank and passing under the loins to the other side keeps the legs in the right position, and gives more room to the operator. When on the ground the head should be kept well back, as this lessens the liability to injure the spine and lumbar muscles, and also reduces the tendency to struggle.

Some operators cast the colt on the near or left side, and fasten the ropes while in that position, instead of casting on the off side and turning the animal over. It is, however, open to the objection that the under leg is then fixed in a crooked position, and during struggling a fracture of the thigh may result. If, however, the lower rope is brought under the back and fastened to the fetlock of the upper leg in the form of a back rope there is not so much risk.

Care should be taken to fix the legs evenly; if one is tighter than the other an accident may happen. It is the details that matter, and a method that has proved successful should be continued. It occasionally happens that even with the greatest care an accident occurs: the horse may break a leg, injure the spine, or strain the lumbar muscles, and for this reason the standing method of castration has been largely resorted to.

Method of securing when Chloroform is given to the Horse Standing. Appliances.—A strong head-stall or cavesson with long rope attached; a chloroform muzzle; double side-line.

The head-stall should fit tightly over the angle of the jaw, so that it cannot slip off, and should be placed higher up the nose than usual. The rope should be attached to the front of the nose-piece, and the other end run through a ring in the wall or round a post, the horse being held up close to the wall. The muzzle may then be applied and the anæsthetic given, or the side-line can be put on first.

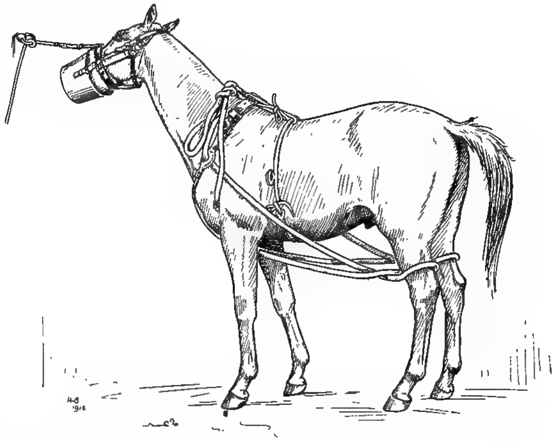


Fig. 197.—Method of chloroforming standing with side-lines and back rope applied. Before casting, the side-lines are lowered to the pasterns.

The ropes should be above the hocks, and the two loose ends tied tightly over the withers.

When the animal becomes drowsy, reels in his gait, or shows a tendency to fall down, the ropes should be slipped down into the heels and the animal cast in the usual way. One man at each rope is usually sufficient, as there is practically no struggling. The man at the head gradually releases his rope, and when the animal is down holds the head and muzzle in position.

For castration it is only necessary to pull up the top hind leg and secure it, when the operation can be quickly and humanely performed.

The above method is one the author has found the most successful, but some practitioners allow the horse to walk round in a circle until he is sufficiently narcotized, and then is either pulled down with a rope round the hind heels, or is allowed to fall down.

The objections to allowing the horse too much freedom are, that being under the influence of the anæsthetic he is sometimes difficult to lead, even with two ropes, one on each side of the head-stall, and when in the excitement stage is apt to be violent and injure himself and the attendants.

Nelder's, Gibson's, or Roberts' muzzle is probably the best for the purpose.

Mr. Parker's Method.—A very simple and effective method of casting an animal for castration or any operation in the region of the scrotum is that of Mr. J. H. Parker, M.R.C.V.S., Farringdon.

It lessens the risk of injuring the limbs or back to a minimum, and after twenty-five years the originator claims that he has "never had a colt hurt itself."

A rope about 10 yards long is used, which is applied round the near fore pastern, then passed to the back of the near hind pastern from without to within, folded over the fixed part once and brought above the near knee under the neck to the off side.

Two men are usually sufficient to pull the colt down, with the help of a man at the tail and one at the head.

The free hind leg is then fixed in the ordinary way, by means of a rope attached to the pastern, passing over the withers, under the neck, and fastened to the fetlock again, the free end then being passed round the leg above the hock to expose the scrotum better, and is held by an assistant. The other rope is held at the back of the animal.

If a very strong horse has to be dealt with, the off hind leg may be roped before it is cast, the free end passing over the back and being pulled by an assistant in that position.

Miles' Method and modifications of it are used by many practitioners, and although rather complicated are very safe both for the animal and operator.

Two sets of ropes and hobbles are used, one consisting of four shackles to go round three pasterns and just below the knee of one fore leg with a long rope, which is looped round the other pastern and then run through the shackles. The other rope is put on in the same manner as the ordinary double side-line, except that instead of being both in the heels they are first placed above the hocks, and only one is let down into the heel just previous to casting, which is done chiefly by means of the shackle rope. When down, the shackles are removed in turn, and the side-lines used to secure the hind legs in a somewhat similar manner to that described before. The fore legs are fastened by knee bands.

If a colt is operated upon, the shackles are only removed from the uppermost hind leg, which is pulled forwards and fixed by the side-line, the other three legs being fastened together by the shackle rope.

The leather hobbles now commonly used by most practitioners can be employed instead of the shackles, the side-lines being put above the hocks until the horse is cast, then slipped down into the heel, and the upper leg or legs released as in the preceding method.

Casting Hobbles.—For older animals and for most operations these hobbles are most serviceable. There are several kinds, but most of them consist of four leather straps with buckles and two iron D's, one fitting into the other, through which a chain and rope passes. The hobbles fit round the pasterns, and the buckles allow them to be fitted to any size of horse.

The same precautions as for casting with ropes should be taken as mentioned on page 861.

The procedure is as follows:

The head should be secured by a bridle, blinkers, or blinds applied, and with some horses a short twitch tied to the bridle is advisable. A surcingle is put on, or instead, a rope is placed round the body, between the fore legs and over the withers, to pull the horse on to the side required.

If the horse is to be cast on the off side, the near fore leg is held up, the key hobble applied to it, and the chain attached by means of a screw. One man standing at each leg adjusts the hobble and quickly passes the rope through the D's in the following order: near hind, off hind, off fore, and near fore.

The legs are put as close as possible to each other; when at a given signal the near fore leg is let down, the man at the head pushes the horse back, the men on the hobble rope pull, and the assistant on the back rope or surcingle pulls the horse on to the off side, then quickly gets on to the neck of the animal, assisting the man at the head, who endeavours to keep the neck well extended. The legs being pulled up together as tightly as possible, a spring hook is put on the chain to prevent it slipping. The hobble rope should be held by one or two men to prevent struggling and injury to the heels and coronets.

If this method is quickly and carefully carried out there is little risk of accident. If, however, the horse is not pushed back, but allowed to fall forwards on to the neck or point of the shoulder, a fracture of one of the cervical vertebræ or humerus may result. Also if too forcibly pulled over on to the side a fractured rib or serious internal injury may be the consequence.

To prevent undue struggling the head may be pulled round to the shoulders, and attached to the surcingle by means of a rope fastened to the bridle or head-stall, or an extension apparatus may be applied forcibly to extend the head, by means of a rope attached to the surcingle behind and the poll strap of the head-stall in front.

Cross Hobbles.—In order to facilitate operations on the legs it is sometimes necessary to detach one or more legs from the hobbles. This is done by unclasping the buckle after previously securing the leg by means of *cross hobbles*. These are usually made of leather in two parts, one to buckle round the fore leg above the knee, and the other round the hind leg above the hock. The legs are then brought into position by buckling the two parts together. A strong cotton rope answers the purpose if put on in the form of a figure 8 round the two legs and fastened in the middle.

To fix the hind leg forwards for operations in the region of the thigh probably the best method is the following :

A long rope made of strong webbing is attached to the hind pastern, brought between the fore legs, under the neck, over the withers, and fastened above the hock of the same leg, or passed round the leg and held by an assistant standing at the back of the horse.

It should be noted here that forcible extension of a limb or fixing with cross hobbles, etc., increases the liability to fracture during the struggles of the animal, and to obviate this a tourniquet may be tightly applied above the hock.

Operation Tables.—Several of these have been invented both in this and other countries. They offer special advantages both to the operator and the animal.

The reasons that militate against their general use are their expense and the fact that they are fixtures, the patient having to be brought to the table, which is not always convenient or possible.

Most of the tables consist of a large padded platform, to which the horse is fastened while in a vertical position, by means of several girths going round the body and neck, the legs being fixed with hobbles and the head by a strong head-stall.

The table works on a hinge, and is placed in a horizontal position for operations.

To release the horse the table is brought back again to its original position and the horse unfastened.

The table devised by Messrs. Dollar & Vinsot is the one most commonly used now.

It is 7 ft. 6 ins. long by 2 ft. 6 ins. wide by 8 ft. 6 ins. high, so does not occupy much space. It is made almost entirely of iron, and is very durable.

The advantages claimed for it are that it has abolished the dangers of breaking a horse's back or limbs when casting on a straw bed ; its use causes no alarm, and a horse is secured with as little disturbance as when being harnessed to a vehicle. As compared with old methods the time consumed is only one-eighth to one-tenth ; the machine is always ready for use, and the horse is put in and fastened in a few minutes.

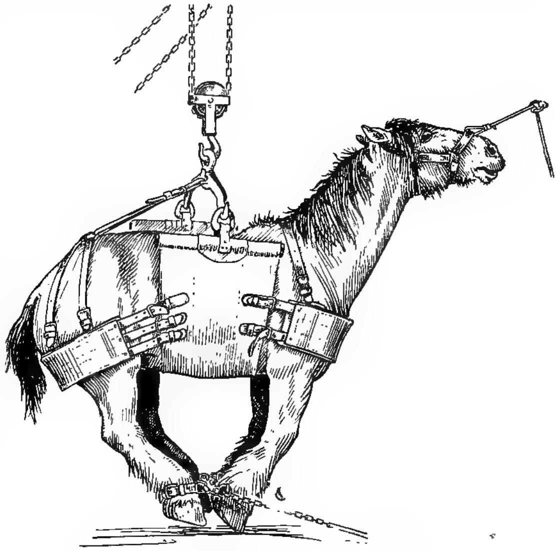


Fig. 198.—Casting a horse in a confined space, using slings and hobbles.

The animal may remain standing, although, incapable of resistance, it may be rotated to either side and to any extent.

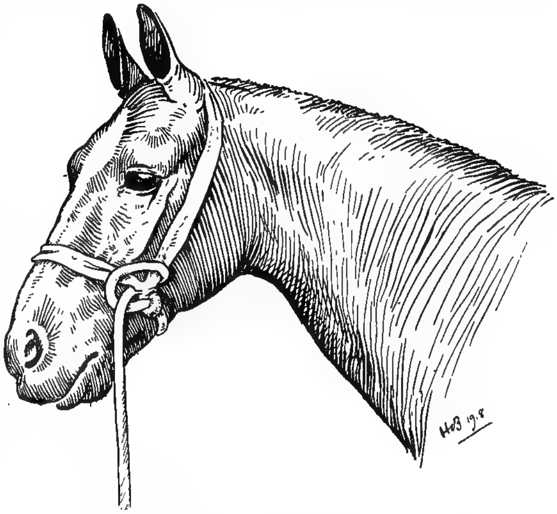


Fig. 199.—Correct method of hitching a halter. (Knot tied loosely.)

Owing to the absence of a straw bed and its attendant dust, and more particularly to the fact that the horse is lifted off its feet and returned to the standing position without any struggle, perfect antiseptic treatment can be carried out.

Unfortunately, however, the table is only suitable for some operations. The horse requires very careful and skilled fastening, and it is usually necessary to employ complete narcosis in order to get the necessary stability for operation.

Method of Casting on a Hard Floor in a Confined Space.—It sometimes happens that an operation has to be carried out in a confined space, where the floor is too hard to allow a horse to be thrown, and where there is no operating table. The following procedure is quite useful :

The horse is placed in slings provided with pulley blocks and endless chain, also with breast strap and breeching. A stout head-stall is put on, the rein being run through a ring in the wall and held by an assistant.

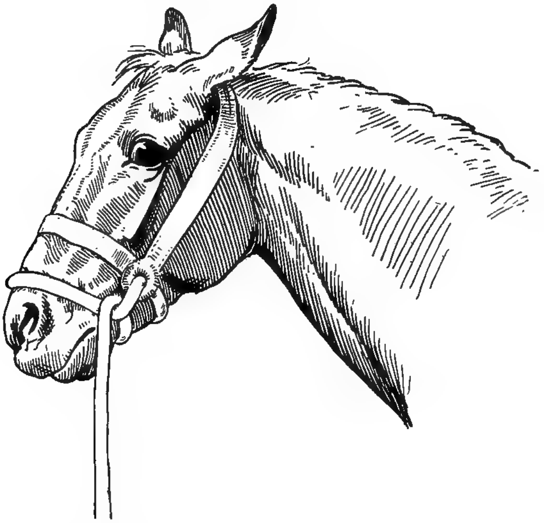


Fig. 200.—Nose restraint for leading a restive horse.

Casting hobbles are placed on the legs and the four feet brought up together and secured by the spring hook.

The slings are then lowered until the horse is resting on the ground, the head being also gradually released at the same time. The men holding the hobble rope can pull the horse to whichever side is required. In this way there is no danger of injuring the ribs by falling on the hard floor, but of course straw should be provided.

The Halter.—Before completing these notes I feel constrained to describe exactly how a halter should be applied and fastened. This may seem superfluous to some, but from long experience among agricultural students and others, and especially considering the appalling misery and waste of horse flesh during the late war from want of this knowledge, I have come to the conclusion that to some, perhaps, it may be useful.

It would be difficult to estimate how many horses have been injured and perhaps spoilt for life from not being fastened properly, to say nothing of the number of halters which have to be cut through from not being able to untie the knot.

Method of Application.—The halter should be loosened and the nose-piece held in the two hands while the horse is approached on the near side. The nose-piece is put over the nose, then the hands are slipped up the cheek pieces and the halter lifted over the ears and adjusted in the right position.

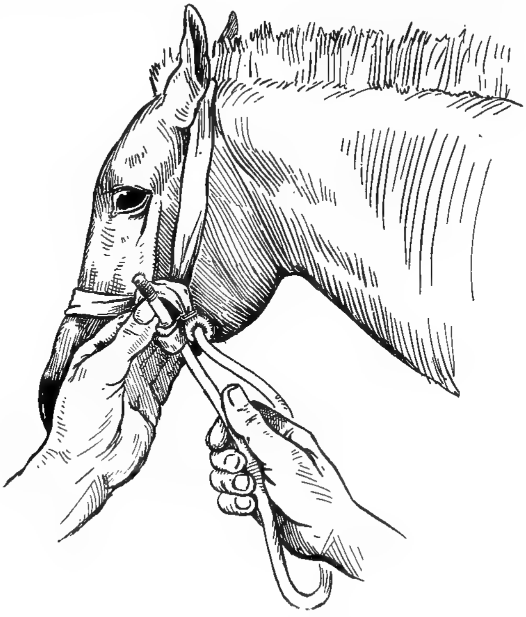


Fig. 201.—Correct method of making a halter smaller.

With unbroken animals it is sometimes best to put the halter over the ears first, and allow the nose-piece and shank to fall over the nose, or the rein is first slipped round the neck and held while the halter is put on.

A horse should never be led or tied up without first hitching the halter so that it cannot pull tight and injure the jaw.

I have known cases where horses have been tied up for days without being able to eat or drink, from neglect to carry out this simple precaution. In other cases, when the rope becomes tight the horse gets restive, runs back, and may injure himself, the vehicle, and the passenger.

There are several knots ; the commonest one is tied round the shank under the jaw. This is objectionable, as it comes into contact with the sharp edge of the bone, and if left on long, may cause a large raw wound. Also it tends to get very tight, and in wet weather it is very difficult to untie. A better method is to fold it round both the nose- and cheek-pieces. The knot is then on the side of the cheek, never too tight, and never chafes the animal.

To fasten the horse the knot used should be one easily untied in case of emergency. If the slip knot is adopted, the ends should be put through the loop; if then the horse gets the end of the rope in his teeth he cannot pull it undone.

The army method is to form a clove hitch round the rail or ring.

A useful method of making a halter smaller is to seize the cheek-piece in the left hand, twist it round to form a loop through which the end of the rope is passed. This may be done several times if necessary until the right size is obtained.

Restraint of the Ox.—The ox differs from the horse both in temperament and in its means of defence. Although a quiet attitude is always to be advised, especially in dealing with cows, yet it will be found that the intelligence of the ox is much inferior to that of the horse, and little can be done without fixing the animal in some way.

The chief weapons of defence or offence are the horns and hind legs, and the operator must guard against both.

It has to be remembered that a bovine animal can kick forwards and outwards, "cow kick," while a horse usually only kicks backwards.

It is not often necessary to cast the ox, and most minor operations can be performed in the standing position; it is usually only required to secure the head, and the animal will remain quiet.

Securing the Head.—The method will depend upon the size and temperament. If a bull or wild bullock has to be dealt with, it is best to throw a rope in the form of a noose over the horns or round the neck and run the other end round a post or through a ring in the wall. As the animal plunges forwards the rope is pulled and the head drawn tightly up to the post, where it is secured. The head should be fixed about one foot from the ground.

In the case of a quiet animal it is usually only necessary to grasp the horn with one hand and seize the nostrils with the other, firmly pressing the septum nasi between the thumb and fingers. This causes a certain amount of pain, and distracts the attention of the animal from the seat of operation. If the head is pulled round to the side and the operator presses his back well into the shoulder of the animal, a strong beast can be held for some time until the fingers get tired. To obviate this a *nose clamp* or *bull-dogs* may be applied to the nose.

There are several kinds: some in the form of tongs, the handles of which have to be held; others provided with a sliding keeper or screw which keeps it in position.

Probably the most useful design is one with a spring keeper and handle in the form of a ring. A rope can then be attached to the ring, and the head secured in whatever position is required. It is especially useful for raising the head for intra-tracheal injections. For this purpose the rope may be passed over a beam and held by an assistant. An ordinary rope can also be utilized. After being tied round the horns a loop is passed round the head between the eyes and the nostrils, or if it is required to drench the animal the loop is placed round the top jaw only, and the head raised either by passing the rope round a beam or by an attendant.

Bulls should always wear a ring in the nose; they can then be easily caught, and led about by means of a pole or rope with a spring hook attached. The advantage of a pole is that the bull cannot get too near the attendant.

A short chain is sometimes left on the ring in the case of vicious bulls, so that when they lower their head to charge they tread on the chain, which acts as a deterrent.

A very effective appliance was introduced by M. Vigan. It consists of a pole of sufficient length to reach from the withers to a point about one foot beyond the muzzle. A surcingle or rope is placed round the body, which passes through an iron staple at the end of the pole. At the head end of the pole is an iron handle, while just over the nostrils is a hook which is inserted into the nose ring. A rope is passed round the horns and attached to the pole. By taking the handle in his hand the operator is able to raise or lower the head at will, and the most vicious animals are thus easily controlled.

Securing the Head and Tail.—A simple method of securing animals for some operations is to fix the head as described previously, and then pass the tail through the slats of a gate or over the top of the stall and hold it securely in that position. The animal can then neither turn round nor lie down.

Administering Medicines.—With quiet animals one man can usually secure the head by passing his arm over the nose in front of the horns, inserting his fingers into the corner of the mouth and lifting the head upwards, the drenching horn being manipulated with the other hand.

If two persons are required, one stands on the off side and holds the horns, while the other seizes the lower jaw, pushing it upwards, and administers the drench. If the animal is very restive the nose is seized with the fingers or nose clamp with one hand and the near horn with the other while the operator gives the medicine.

The preceding method is preferred by some, as the head and neck are held then in a horizontal position, and there is less fear of choking the beast.

Securing the Fore Legs.—This may be done by means of a rope round the heel, passed over the animal's back and held by an attendant, or a knee-strap may be used similar to that described for the horse.

Securing the Hind Legs.—It is unfortunately a common habit for cows to kick while being milked, or while the teats and udder are being manipulated, and there are several methods employed for preventing it.

(1) The simplest preventive is by means of passing the tail between the legs and round the hock, where it is held securely. When the cow lifts the leg to kick, the pull on the tail brings the weight on to that leg again, and so acts as a deterrent.

(2) A rope is attached to the leg above the fetlock on the milking side, and tied to a post or ring in the wall behind the cow.

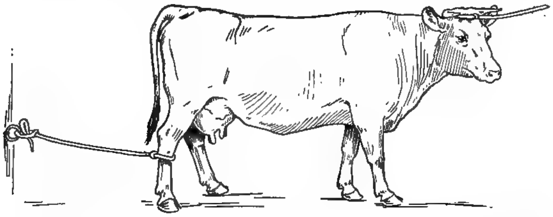


Fig. 202.—Method of securing a kicking cow during milking.

(3) *Hock Straps.*—A leather strap with a D and a buckle is used. It is first put round one hock, through the D, and then buckled round the other.

(4) A rope is looped round one hind leg above the hock and then passed backwards and forwards round the legs, forming a figure 8. It is tied in the middle between the legs, or if necessary after tying, the end is held by an assistant standing behind the animal.

(5) A rope with two loops is passed round the hock, and tightened up by means of a stick passed through the loops, after the manner of a tourniquet. This inhibits the use of the leg, but being painful is scarcely to be advised during milking.

Other methods which may be employed during operations on the under parts of the body are:

(*a*) Place a round stout pole in front of the hind legs, one end resting on the ground, the other being held at the height of the body by an assistant. If the animal is placed against a wall and the head secured, it is unable to move far in any direction.

(*b*) It also may be secured against a wall by means of a rope attached in front to a ring or post, about the level of the elbow, and carried round the animal to a ring immediately behind on a level with the stifle. By pulling on the rope the animal is pressed against the wall.

To lift One Hind Leg.—It sometimes happens that cattle need attention to their hind feet, and it is no easy matter to secure the leg in the right position to use the knife. A good method is to place a round pole, *e.g.* a broom handle, in front of the hock of the leg to be lifted, and behind and above the opposite hock. The ends are lifted by two men upwards and backwards.

Another way is to fasten a rope to the fetlock and pass the loose end over a beam above and slightly behind the cow. The rope is pulled by an attendant, the foot being seized at the same time by the operator, allowing it to rest on the knee after the manner of shoeing a horse.

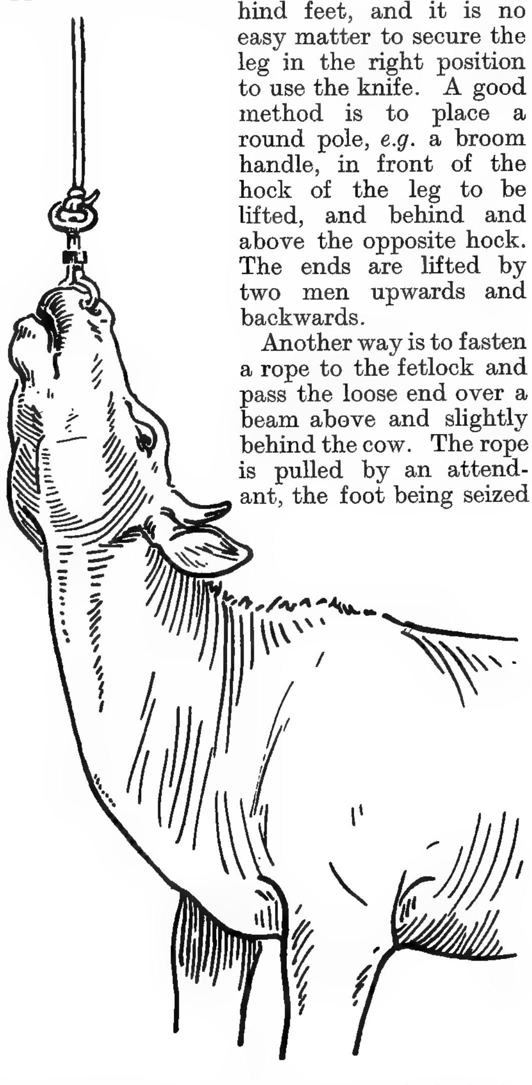


Fig. 203.—Method of restraint for intra-tracheal injection.

Casting.—Casting the ox is comparatively an easy process compared with the horse, and is not attended by such great risks. It is rare for the ox to sustain a fracture of the limbs or vertebræ, but it sometimes happens that the horns are broken off during the struggles of the animal; also the rumen may be ruptured if too distended at the time of operation. The greatest danger is in casting the pregnant cow. This should be avoided if possible, as abortion frequently results. In all cases a soft bed of straw should be provided, the animal should have the head controlled by a halter or rope round the horns, and a nose clamp, and it should have been fasted for at least twelve hours.

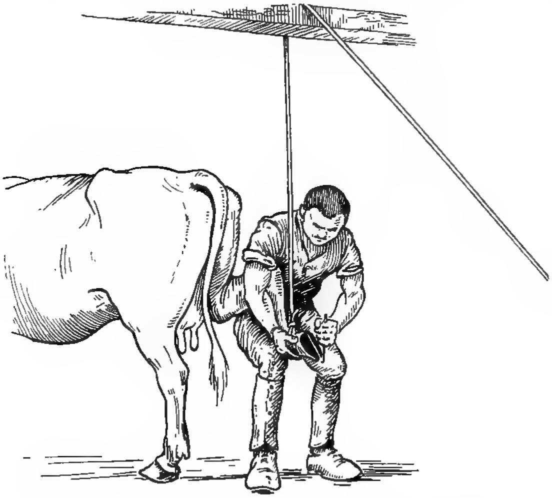


FIG. 204.—Method of lifting a cow's hind leg in foot-dressing.

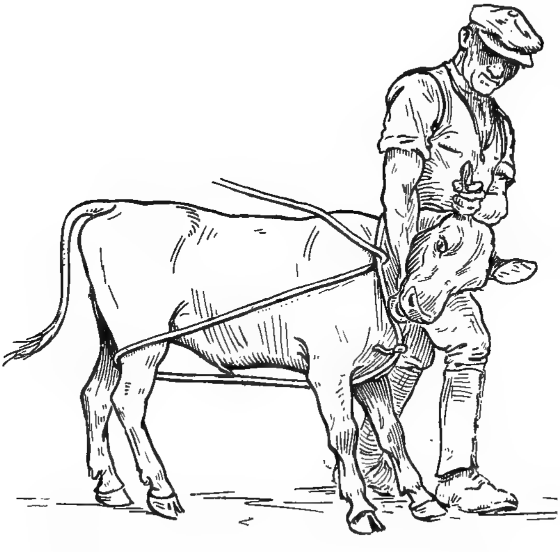


FIG. 205.—Method of casting calf for castration.

Casting for Castration.—Very often calves are operated upon standing, but the operation is simplified and done in a more aseptic manner in the recumbent position.

A short rope with a loop in one end to fit the neck is thrown over the head—a halter opened out answers very well; the end is passed between the hind legs and back through the neck loop on the *right* side, brought over the back, and pulled by an assistant, while the head is seized by the lower jaw and twisted upwards and towards the right side by another assistant.

The calf quickly falls on the left side, a turn is made with the rope round the shank of the upper hind leg, exposing the seat of operation, and is held there.

Reuff's Method.—In casting older animals, especially cows, Reuff's method, which may be called "the method of persuasion," is to be advised.

A long rope is necessary. One end is fastened round the horns, then half-hitches are made respectively round the base of the neck, the chest, and flank, the free end being carried backwards over the hip. The head is held by an assistant or fixed to a post, while two assistants apply traction to the rope, either from the right or left side according as it is required, to throw the animal on the right or left side. The body being gradually compressed by the rope, the ox in a few seconds quietly lies down, and will remain down as a rule, while the pull on the rope is maintained. It is best, however, in lengthy operations, to secure the legs by another rope or hobbles.

Double side-lines may also be used in a similar manner to that described for the horse. As, however, it is somewhat difficult to keep the ropes in the hind heels, and chafing often results, it is best to use small hobble straps round the heels, through the D's of which the ropes may be passed, or the hobble straps may be put above the fetlocks.

Another method is to fix the rope to the horns first, instead of passing it round the neck; the side-lines then go between the fore legs as before.

Hobbles.—Small English casting hobbles are also very effective. The leather loops should then be placed above the fetlocks, otherwise the procedure is the same as for the horse.

Casting with Rope on Three Legs.—This is a convenient method if the hobbles are not at hand.

A loop is made at one end which is placed round the near fore heel; the rope is then carried round the off fore pastern, from behind, forwards and inwards, thence round the off hind pastern, and back around the part of the rope connecting the fore legs. The rope is pulled backwards, and the three legs being drawn up together, the animal falls over and is secured.

It is sometimes necessary to *roll the cow*; *e.g.* to rectify torsion of the uterus.

The cow is cast by one of the preceding methods, preferably Reuff's. The legs are tied in pairs, one front and one hind around the shanks, and held in position by a rope attached to the legs and passing round the back of the animal. The cow thus secured can be rolled over repeatedly with little danger either to the animal or operator.

The Dog.—It should be remembered in handling dogs that they are very nervous and sensitive animals. A kind word and a gentle caress will often do more than severe restraining methods. It is not every individual who has the gift of giving confidence to his patients; some possess it in a remarkable degree, and consequently they can do almost anything with animals, especially the dog, which possesses a remarkable instinct of self-preservation, and can tell instinctively if any harm is anticipated.

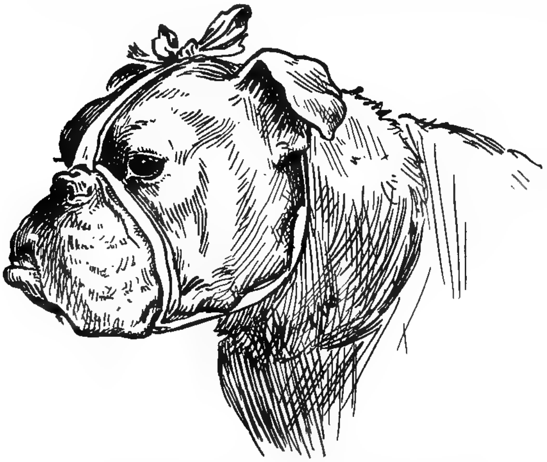


Fig. 206.—Tape muzzle for short-nosed dog.

Not many dogs are naturally vicious, but occasionally they are met with, in certain breeds such as the chow, mastiff, Airedale, and bull terrier, and the operator can generally judge of this by the demeanour of the dog and the expression in the eyes.

Muzzles.—It is always wise to secure the mouth, and there are various muzzles made for this purpose, some wholly of leather, and others of wire with a leather strap going round the neck. The leather muzzle is to be preferred, as it is lighter and more comfortable for the animal, and if used to prevent interference with an operation wound it is less likely to lacerate the parts.

Many muzzles are made to fit too closely over the nostrils, while leaving a large space between the lips, and it is often necessary to have another piece of leather sewn on in this position, especially when it is desired to prevent the dog from picking up garbage or from licking a wound.

Tape Muzzle.—A very good muzzle can be made with a piece of tape or narrow bandage about 2 to 3 ft. long. It may be folded to form a clove-hitch, which will not slip, or simply tied round the nose with the knot under the jaw, the loose ends being brought round on each side of the head and tied securely at the back of the neck. As an extra precaution the ends may be then tied to the collar. For short-nosed dogs, such as the bulldog or pug, the ends can be brought down the middle of the skull and tied round the nose-piece, so relieving the pressure on the top of the nose, also ensuring that it does not slip off.

To make the clove-hitch two loops are made in the tape, the second one being placed behind the first.

It can very readily be removed by untying the knot and pulling one of the loose ends. If no tape or string is available, the dog is best held by grasping the skin at the back of the neck with one hand, while the other is held round the jaws, or below the bottom jaw, an assistant grasping the two fore legs to prevent scratching.

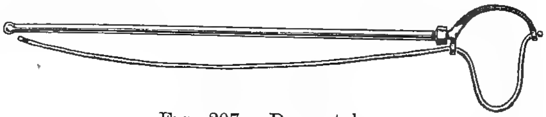


Fig. 207.—Dog catcher.

Dog Catcher.—If there should be any difficulty in catching the dog, a "catcher" made of a long stout pole with an iron piece at one end, curved to fit the neck, and two eyelet holes to receive the rope. The rope should be a little longer than the pole, so that it may be passed loosely over the dog's neck, then pulled tight and the rope twisted round the pole. The dog is thus prevented from approaching the operator, and can be further secured at leisure. If the iron part of the catcher is sufficiently bent there is no fear of strangling the dog.

To administer medicine in the form of a pill, the top jaw should be grasped with the left hand, pressing gently the lip on the upper teeth, which induces the dog to open the mouth and also makes him disinclined to bite for fear of injuring his own lips. The pill is then administered with the right hand.

For this operation an assistant should firmly grasp the dog at the back of the neck with one hand and with the other press the dog's head upwards or hold the fore legs.

To administer liquids one hand should lightly hold the nose upwards, while the commissure of the lips is pulled out and the medicine gradually poured in, an assistant holding the dog as before. This is much better than attempting to pour liquid into the front of the mouth. The animal, fearing to be choked, struggles, usually spills the medicine, and may bite the operator.

Gags.—To examine the mouth and throat, or for dental operations, various appliances have been invented. The gag suggested by Mr. Gray is very useful. It fits on to the canine teeth, is made with a bend in it to prevent it being pressed together, and has a spring which opens it, so keeping it in contact with the teeth.

It is best to apply a tape muzzle first to prevent the jaws being forced open too wide.

Another good gag is Hobday's, which consists of bars which are put in the mouth and strapped over the jaws. The mouth is opened by two screws, one on each side, separated by turning two nuts.

Messrs. Arnold also have invented one which works on the same principle as Gray's, and is very effective.

If no gag is available two pieces of tape may be placed in the mouth beyond the canine teeth, one being tied round the top jaw and one the bottom. The mouth can then be held open while an examination is made of the interior.

Operating Tables.—In order to secure the dog for operation purposes it is necessary to strap him down to a table.

There are several specially prepared tables for this purpose, but as they are not always at hand, an ordinary kitchen table may be utilized.

Four double pieces of strong tape are folded to form a running loop, which is put round each leg above the hocks and wrists, and the ends tied to the legs of the table, or to hooks placed there for the purpose. The dog is then muzzled and stretched out, so that he lies flat on the table.

Clamps to fix on the table with adjustable sliding cords attached are an improvement on the preceding method, as they can be placed anywhere on the edge of the table, and can be adjusted according to the size of the dog.

A table can be made from a strong board about 6 ft. by 3 ft. with a number of holes punched out to fit an ordinary key. It should be made of some strong hard wood, with cross pieces on the under surface to raise it high enough to allow a key to be put through from above.

To render it easily cleaned it should be painted with enamel. It can then be placed on another table or on trestles.

Hobbles are made of strong webbing or strips of raw hide, and attached to the keys. The front legs are secured first, and then the hind ones are stretched backwards as far as they will go, but not unduly to strain the animal, an attendant at the same time holding the dog and pressing gently on the back. The dog may be placed on its back or abdomen, and the legs may be fixed in whatever position is most suitable for the operation.

It is a good plan also with a large strong dog to tie a rope completely round the dog and table. To lessen the excitement, straining, and fright, it is often advisable to administer a dose of morphia hypodermically about an hour before the operation; there is then no difficulty in securing the animal, and if a general anæsthetic has to be given, *e.g.* chloroform, the anæsthesia is considerably aided.

For vicious dogs morphia is a very great boon, even for minor operations.

Of the special operating tables probably those suggested by Livon and by Hobday are the most useful. Hobday's is made of metal, is about $5\frac{1}{2}$ by $2\frac{1}{2}$ ft., and provided with stout trestles to render it stable during operations. It has the great advantage of being easily moved about and sterilized.

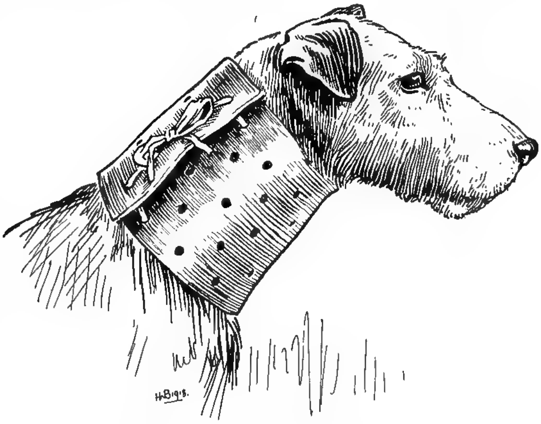


FIG. 208.—Leather collar.

Another form of table is made in the shape of a trough. This allows the fluids to be easily drained off, which is an advantage during some operations, and it also prevents too much lateral movement. Macqueen, Bernard, and Young have suggested various modifications of this table.

After operations have been performed it is very difficult to keep our patients quiet, and to prevent them scratching the wounds. Whenever there is irritation, the dog wants to scratch or rub the part, especially if it is in the region of the head.

A broad collar made of tin or leather, called an *Elizabethan collar*, may be usefully employed. It is made in several sizes to fit the neck, and prevents the dog turning his head.

Stiff cardboard or leather may be cut out to enclose the neck, and holes made along the two edges, through which a tape is laced. If this is put on tightly it stops much lateral movement.

Sometimes, however, it is necessary to put the animal in a bag, the mouth of which should be tied round the neck of the patient.

To prevent scratching with the legs, a tape may be tied round the fore or hind legs just above the feet. There is just sufficient room for the dog to walk, but not to allow him to put one leg on the ground and scratch with the other.

The Cat.—Although the domesticated cat is a gentle enough animal when unmolested, yet one has not to proceed very far with any method of restraint to realize that it is not very far removed from the wild state, and that it is essentially a feline animal, strong, agile, resourceful, and possessed of very adequate means of defence.

Bites or scratches from cats are dangerous, as the wounds inflicted are usually deep, and owing to their habit of scratching in garden earth, tetanus has been known to result. It therefore behoves every operator to protect himself in every possible way.

To secure the claws a strong square towel or cloth should be placed on a table, the cat lifted upon it, and the ends tied tightly crosswise over the back. The head can then be firmly grasped with the left hand and pulled upwards while medicine, etc., is being administered.

Another method is to roll the cat several times in a strong cloth, leaving out the head, but bringing the cloth tightly round the neck, where it is held securely.

For operations upon the back parts, such as castration, the cat may be held by an assistant in the following manner: With the cat resting on a flat surface the hind legs are seized above the hocks between the third and fourth fingers of each hand, the fore legs between the second and third fingers, leaving the thumbs and first fingers to grasp the head above and below. The cat is then lifted up into a convenient position for operation.

This method needs some skill, pluck, and strong fingers, but is by far the best way of holding a cat for castration.

From time immemorial a jack-boot has been utilized, the cat being placed head first into the boot, while the tail is seized and held firmly by an assistant. There is, however, a good deal of struggling, and this method is not commendable.

Some operators roll the cat in a cloth, the head being also included, but the back parts exposed. There is some danger of suffocation by this method if the operation is delayed, but it is very effective.

Several different kinds of tables and hobbles have been invented by means of which the cat can be strapped down.

Hobday's operating table answers admirably, the cat being secured in the same way as described for the dog, care being taken that the tapes are drawn very tightly round the legs, just above the paws in the fore legs, and above the hocks in the hind limbs.

Failing a special table an ordinary kitchen table can be utilized, and the cat's legs tied by means of tapes to the legs of the table.

Mr. Gray has suggested a very useful rack, made of two iron bars with clamps at each end, to fix to the edge of the table. The cat is then stretched out between the bars, to which it is secured by tape hobbles.

Securing the Pig.—Aged boars and sows are sometimes vicious, and care has to be taken in approaching them, but this is the exception.

In all cases pigs should be driven into a confined space, and the operator should be provided with a *wooden tray* about two to three feet in breadth and about two yards long, which can be placed in front of the person to act as a shield, and also to drive the pig into a corner and secure him against the wall; there is not then much difficulty in catching the animal.

With small pigs it is usual to catch hold of one hind leg or the ears. If an operation such as castration has to be performed, the head is placed between the legs of an assistant and the two hind legs are held upwards, one in each hand, wide apart, which exposes the scrotum in a convenient position for the operator.

The operator, on the other hand, may choose to hold the pig's head between his own knees, while the assistant seizes the hind legs. In either case care should be taken not to squeeze the chest too hard, otherwise death may result.

To catch larger pigs, a running noose may be skilfully dropped over the top jaw, taking care that the rope is placed beyond the tusks, or it will slip off. This is pulled up tight, and the loose end passed round a post. The pig hangs back, so tightens the rope, and can then be further secured if required.

Another method is to take a stiff piece of cord attached to a stick with a running loop, in which some solid food is placed. When the animal opens its mouth to take the food, the noose is slipped over the snout and the pig secured.

A crook similar to that used for the sheep can be utilized, or a mechanical hog-catcher with jaws, attached to a pole and operated by a rope, can be used to seize one of the hind legs.

To secure the Head.—A twitch may be applied, similar to the one employed for the horse. This is passed over the upper jaw, or round both jaws, and tightened sufficiently to prevent it coming off.

A device called the *Champion Hog Holder* is very useful. It is made entirely of metal, has a loop slightly bent at one end, which goes into the mouth, fitting over the top jaw, and a handle at the other end. One man can easily restrain the largest boar by depressing the holder, and so squeezing the nose.

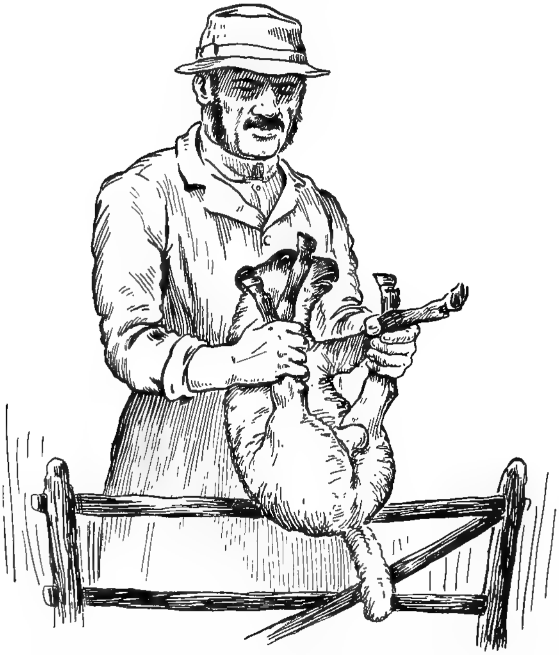


FIG. 209.—Method of securing lamb for castration and docking.

To administer a Drench.—This is always a risky operation in the case of a pig, but when it is necessary the animal should be seized by the ears by an assistant, who stands with his back to a wall with one leg on each side of the animal, and if not too heavy lifts its fore legs off the ground. An old boot with a hole cut in the toe is then put in its mouth, and the medicine poured slowly into the top of the boot.

To cast a Hog.—One man holds the ears, while another reaches over the back, seizes the hind leg, and by a combined effort the animal is thrown on its side, where it can be secured by tying its legs together by means of a soft rope around the shanks, an assistant pressing his knee on its neck.

Securing the Sheep.—It will not be necessary to describe in detail methods of restraining the sheep, as it is easily controlled and has no effective methods of defence.

It is usually sufficient to seize it round the neck with the left arm, and with the right hand grasping the hind leg or the wool of the flank "turn it" on to its buttocks. The sheep being propped up between the legs of the shepherd, can be given medicine or operated upon without much difficulty.

The sheep may also be turned on its side, and held down by a little pressure on its neck, or the legs may be secured by tying the limbs in pairs, the cannon bones of the front and hind legs on each side being placed parallel to each other, and secured in that position by a soft rope.

Castration.—For this operation the shepherd seizes one hind leg above the hock in each hand, and lifts the lamb with its back pressing against his chest; the parts are then exposed, and the operation quickly performed.

Stocks.—A very simple and effective means of securing a sheep in the standing position for "trimming," paring the feet, or dressing the skin, is by means of stocks. This is easily made from a stout piece of soft wood, cut in the shape of a fork at the top of sufficient size to admit the neck of a sheep. Holes are made on each side of the forked piece through which an iron peg is passed to secure the head. The bottom of the appliance is sharpened so that it can be driven into the ground. It can thus be taken about by the shepherd and used wherever the sheep may be.

For obstetric work a raised table made out of hurdles is most useful, and should always be at hand during lambing time. The sheep is held by an assistant, and can either be placed on its back or sides, according to the position required. There is then much less risk of septic infection, and the work of the obstetrician is made comparatively easy.

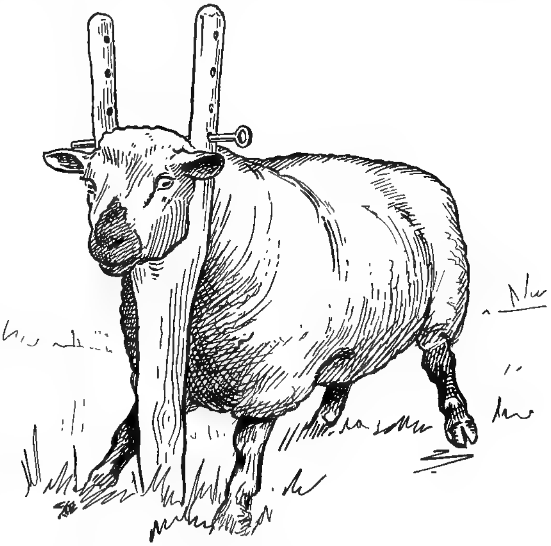


FIG. 210.—Portable sheep-stocks.

G. P. M.

SURGICAL ANÆSTHESIA

Anæsthesia, in the broad sense of the term, is "suspension of sensation," whether due to disease or injury or brought about for surgical purposes by various agents called anæsthetics.

The chief objects of anæsthetics in surgery are the abolition of pain during operations, the prevention of various reflex movements, and the production of muscular relaxation.

Anæsthetics may be either local or general, the former acting only on the part to which they are applied, and the latter acting on the central nervous system and causing complete loss of sensibility. The production of local anæsthesia is thus indicated for surgical operations on limited areas, and also when it is considered dangerous to produce general anæsthesia on account of some defective condition of the patient. General anæsthesia is indicated in the more serious or major operations involving larger areas or body cavities, to relax muscles in the reduction of herniæ and luxations, for the setting of fractures, and in bad cases of dystocia; also, in the case of the dog particularly, to cause relaxation of the abdominal muscles to facilitate the examination of the abdominal contents for diagnostic purposes.

Local Anæsthesia.—Local anæsthesia can be brought about by various means. The old methods consisted of the compression of nerve trunks and the application of cold. The former was brought about by the use of the tourniquet, an agent now rarely used for that purpose, although still of great service in the practice of hæmostasis during operations on the limbs. The application of cold was accomplished by a mixture of equal parts of pounded ice and common salt in a muslin bag and kept on the part for five or ten minutes until it was practically frozen. This method was superseded by the use of a spray of anhydrous ether or of ethyl chloride to freeze the part by rapid evaporation. These methods are rarely advocated now, as both the freezing and thawing processes are more or less painful, and if the part is too well frozen the healing process may be considerably retarded.

The local anæsthetics now employed are various chemical agents which produce paralysis of the peripheral endings of sensory nerves. They include cocaine, eucaine, holocaine, novocain (kerocain), stovaine, acoine, tropacocaine, and hydrochloride of urea and quinine. These may be used singly or in combination, either by painting on to the surface, or by injecting into or round the part to be anæsthetized, or by injecting over the trunk of the nerve supplying the part. Excellent advantage can be taken of this latter method in anæsthetizing the foot of the horse both for operations within the hoof, where for obvious reasons the local anæsthetic cannot be directly injected into the tissues, and also for assisting in the diagnosis of the seat of obscure lameness by the process of exclusion. In such cases the anæsthetic may be injected over the plantar nerves above the fetlock joint.

Cocaine.—Cocaine was the first chemical agent used in the production of effective local anæsthesia. The pure alkaloid cocaine is very sparingly soluble in water, but its salt, the hydrochloride of cocaine, is freely soluble in water and alcohol, and, being equally efficacious, is employed. When a 5 per cent solution of cocaine hydrochloride is applied to a mucous membrane or injected into the cutaneous or subcutaneous tissues, the first noticeable effect is pallor due to vascular contraction occurring in about one minute; two or three minutes later the part has become insensible to pain and touch owing to paralysis of the sensory nerves of the part. This is due to a direct affinity on the part of the cocaine for the cell protoplasm, especially of the sensory nerve-endings. This affinity for protoplasm should be well remembered when deciding upon the strength of the solution to be employed. The writer has frequently observed that when more concentrated solutions than 5 per cent are infiltrated into operation areas, the healing of the operation wound is very materially retarded. The affinity of the cocaine in those strong solutions is such that it actually becomes a cell poison, and either markedly reduces the vitality of the cells or even destroys it, and healing by "first intention" is rendered impossible. The writer, therefore, in the light of further experience, prefers to employ for infiltration anæsthesia larger quantities of weaker solutions and injected at a series of points round the operation area, rather than a smaller amount of a stronger solution injected directly into the site of operation, a view contrary to one which he expressed several years ago when writing on the same subject. For injection into the tissues, 1 per cent to 4 per cent solutions are to be preferred to the stronger solutions, though the latter, from 5 per cent to 10 per cent, may be employed over a nerve trunk to produce conduction anæsthesia of a part below. In such cases the cells of the part directly exposed to the cocaine are not further mutilated by the operation incision, and the ill-effects are not so likely to occur; moreover, the anæsthetization of the remote parts is more likely to be complete. When injected under the skin the area anæsthetized extends over a radius of about an inch round the point of the needle. The insensibility occurs in from three to five minutes and lasts from twenty to thirty minutes.

Dosage.—The amount of cocaine that can be injected with safety and without causing muscular spasms likely to interfere with operation varies with the idiosyncrasy of the patient. In the small or so-called toy dogs one-tenth of a grain (*i.e.* 10 minims of 1 per cent solution) for each pound body-weight is usually quite safe. In larger dogs the same proportion may be employed, but in any given case 2 grains (40 minims of 5 per cent solution or 100 minims of 2 per cent solution) must be regarded as the maximum amount. In the cat the same proportion may be employed, but ¼ of a grain must be regarded as the maximum safe dose.

In the horse the maximum dose is 10 grains, an amount which is rarely required. Some horses are much more susceptible than others, and I have seen great excitant toxic effects follow the hypodermic injection of 2 drachms of a 5 per cent solution (containing about 6 grains of cocaine). Two grains in 40 minims of water injected over each plantar nerve will completely anæsthetize a horse's foot.

For cattle, cocaine may be used as for horses, but is much less frequently employed. It is very useful for the eye in cases of chaff under the eyelids, allowing the foreign body to be removed quite painlessly ; and in the operation for carcinoma of the orbit and tumours elsewhere.

The local anæsthetic action of cocaine is much improved by combining with it solutions of suprarenal extracts as adrenalin, or its synthetic substitutes suprarenin, adnephrin, and renastyptin. These agents cause a contraction of the vessels at and round the seat of injection, rendering the part anæmic, and reducing the local circulation. Consequently, the absorption of the cocaine into the general system is retarded and the local anæsthetic action is rendered more complete and more prolonged. Less cocaine is necessary and the danger of poisoning is thus reduced in both ways. The operation is further facilitated by being almost bloodless. The amount employed is from 5 to 10 minims of 1 in 1000 solution for dogs, and up to 1 drachm of a similar solution for horses.

When small doses of cocaine are absorbed into the general circulation the effect is to act as a restorative and general stimulant of the central nervous system, and is consequently a very useful agent for producing local anæsthesia and minimizing surgical shock in weak animals, especially dogs, when general anæsthesia is regarded as dangerous.

When too large doses of cocaine are injected toxic symptoms are set up. A few minutes after the injection in such cases the patient begins to lick his lips and salivate, the eyes become dilated, and visual accommodation is interfered with, excitement and hyperæsthesia are produced, the ears are moved rapidly backwards and forwards, and there are well-marked muscular twitchings or clonic spasms and interference with co-ordination of movement, while horses paw the ground and are often difficult to control. This state of affairs, and particularly the muscular spasms, obviously defeat the object of the administration of the cocaine, and it is impossible to proceed with the operation until the symptoms subside, which may be several hours later. In the smaller animals it may prove fatal by paralysing vital nerve centres and causing syncope or asphyxia. If one wanted to be certain of killing a dog by cocaine, however, it would be necessary to inject from 5 to 8 grains, according to size, which would be fatal in about half an hour, while from 2 to 3 drachms is necessary to be certain of killing a horse. The best antidotal treatment in susceptible animals appears to be the administration of either morphia or caffeine hypodermically, or a good dose of strong coffee, together with perfect quietness.

Owing to the toxicity of cocaine a number of very useful synthetic substitutes have been introduced, their chief recommendation being that they can be used with much greater safety in the smaller and more susceptible animals. These agents include novocain, beta-eucaine hydrochloride, hydrochloride of urea and quinine, stovaine, holocaine, tropacocaine, acoine, and others.

The writer has had considerable experience with most of them and does not recollect having any untoward results from any of them, using them in precisely the same manner as cocaine. They have each certain advantages over cocaine, and, as with that agent, their effect is improved by a combination with a hæmostatic.

Novocain, and its English equivalent **kerocain** (Kerfoot's novocain), is a non-irritant local anæsthetic freely soluble in water and may be sterilized by boiling. It may be used in similar strengths (2 per cent to 5 per cent solutions) as cocaine, and in larger quantities without the danger of producing toxic effects. The writer considers novocain and kerocain to be about the best of the local anæsthetics.

Hydrochloride of beta-eucaine is also a very good local anæsthetic. Compared with cocaine, it is less toxic, its action is slower in commencing, but is more prolonged. It can also be sterilized by boiling. It is often advantageous to combine cocaine and eucaine in order to obtain the quicker action of the former and the more prolonged action of the latter. When combined the solution should only contain half the percentage of each ingredient.

Hydrochloride of urea and quinine is probably the least toxic of all the local anæsthetics. It is effective in solutions of 1 per cent to 5 per cent, and can be used on quite young animals with perfect safety. It is also very cheap. It is, however, very slow in bringing about anæsthesia and requires to be injected about thirty minutes before operating; while, on the other hand, its effects are very prolonged, extending in many cases even up to twenty-four hours. The advantage of this is very obvious in many veterinary patients, as it reduces the tendency of the animal to interfere with an operation wound during, at any rate, the first day. It does not appear to possess any effective hæmostatic property and may be combined with adrenalin with advantage. I have amputated digits in dogs, and excised tumours in dogs and horses in comfort without any indication of pain in nervous animals that have objected strongly to the primary introduction of the hypodermic needle.

Spinal Anæsthesia.—Intraspinal injections of sterilized local anæsthetics introduced in the lumbar region may be used to produce anæsthesia in the posterior part of the body and the hind limbs. For this method stovaine is usually preferred to cocaine, owing to its lower toxicity and its less depressant action on the heart. Under this anæsthetic quite serious operations in the human subject can be performed painlessly in patients for whom general anæsthesia would be dangerous. Macqueen, in *Veterinary Medicines* (Finlay Dun), says: "The injection is made through the lumbo-sacral space at the point of intersection of two lines, one median uniting the last lumbar and first sacral vertebræ, the other transverse connecting the summits of the internal angles of the haunch." The entrance of the needle into the subdural space is indicated by the escape of cerebrospinal fluid. This method is not in favour in veterinary practice, since equally advantageous results in the smaller animals may be obtained by other means much less dangerous, such as the application of a local anæsthetic in combination with the administration of a full dose of morphia half an hour or an hour previously. The chief objections are the uncertainty of absolute asepsis, the difficulty of injecting the anæsthetic into the proper place and without injury to the spinal cord, and the serious nature of the complications if they should arise in this particular situation. In the larger animals, moreover, the distance of the spinal canal from the skin renders the injection still more difficult. A detailed description by Merillat of the method as applied to dogs is reproduced in *Anæsthesia and Narcosis of Animals* (Hobday).

General Anæsthesia.—As already indicated, general anæsthesia implies a temporary complete suspension of consciousness and of sensation. The writer would differentiate it from narcosis, in that in the case of the latter the loss of consciousness is not complete; an animal can be wakened up by such things as a loud noise or a smack, only to fall off to sleep again without the administration of any further agent; the narcosis is more tardy in being produced, and is much more prolonged. The effect of a general anæsthetic is more rapidly induced, more complete, but more transient. A patient regaining consciousness or awakening from a general anæsthetic does not again lapse into unconsciousness without further administration of the anæsthetic. The difference between the effects of morphia and chloroform well illustrates the point.

The method of induction of general anæsthesia is by inhalation, and the principal agents employed include nitrous oxide, chloroform, ether, and mixtures of alcohol, chloroform, and ether, such as A.C.E. mixture (alcohol 1 part, chloroform 2 parts, ether 3 parts) and A.E.C mixture (alcohol 1 part, ether 2 parts, chloroform 3 parts). Of these chloroform is the most effectual and, if properly administered in veterinary practice, it is a very safe anæsthetic. Proper administration includes the preparation and the preliminary examination of the patient as to the condition of the heart and lungs in particular. If the heart is weak, irregular, or intermittent the administration of chloroform for anæsthesia is decidedly dangerous. The same applies when there is fluid in the chest and, to a smaller degree, in cases of destructive lung disease, such as consolidation or extensive emphysema.

Preparation of Patients for Chloroform Anæsthesia.—The **horse** is an excellent subject for chloroform and requires but little preparation. Except in the cases of urgent operations it is well to keep the patient on a laxative and somewhat restricted diet for a day or two, completely withholding long hay or bulky food the night before, a muzzle being put on to prevent him eating his bedding. On the morning of the operation he may have a limited allowance of water and a small feed, such as a bran mash.

In **cattle** and **swine** the preparation is similar. Both species are quite good subjects.

Adult robust **dogs** are good subjects for chloroform if administered with care. Very young and very fat dogs are bad subjects. Especial care must be taken with the toy breeds and the short-nosed varieties, as bulldogs and pugs. The food should be diminished the day before, and only a light meal given on the morning of the operation, and not within two or three hours of the operation.

Adult **cats** are good subjects for chloroform if plenty of air is allowed, but ether and A.C.E. mixture are usually safer.

Administration of Chloroform

Before administering chloroform, a supply of antidotes should be procured and ready to hand in case of necessity. They should include hydrocyanic acid, strong solution of ammonia, amyl nitrite, solution of strychnine, and adrenalin.

Horses and Cattle.—For the administration of chloroform vapour a muzzle or inhaler is necessary, and there are several varieties commonly used.

(*a*) The simplest one is known as Cox's inhaler. It consists of a cylinder of leather or canvas, which fits on the upper jaw only, passing in the mouth to the commissures of the lips. It possesses a running string round the top, so that it can be drawn tightly round the nose to prevent or reduce the ingress of air. It is held in position by a strap which passes over the poll. The chloroform is poured on to a sponge previously squeezed out with hot water to facilitate volatilization, and is inserted into the free end of the cylinder, which is then closed with a towel to limit the ingress of air. The nostrils should be first smeared with lard to prevent the chloroform blistering the skin, unless the muzzle is made with a wire or string netting across its interior to prevent the sponge coming into contact with the nostrils.

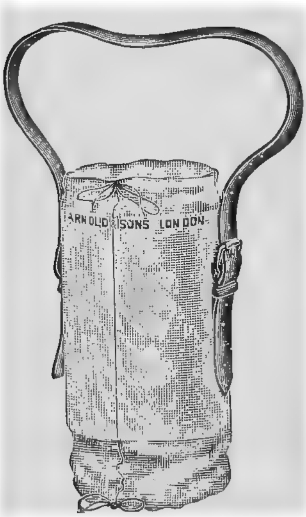


Fig. 211.—Chloroform muzzle. (Cox's pattern.)

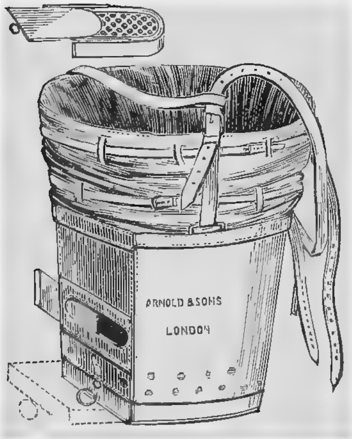


Fig. 212.—Chloroform muzzle. (Carlisle's pattern.)

(*b*) Carlisle's chloroform muzzle is a very good one, but in the writer's experience not quite so safe as the former, as it may exclude too much air and cause asphyxia. It fits closely round the nose and mouth by means of a small bolster, while the other end is quite closed, except for a slot into which fits a tray with a sponge guarded by a wire netting. The chloroform is poured on to the sponge and the tray inserted, and then the end is completely closed by means of a leather flap.

(*c*) Roberts's muzzle, as used by the late Mr. Richard Roberts for the administration of chloroform in the standing position. It consists of a leather cone, fitting tightly over the lower end of the face by means of a bolster and strap. At the lower end of the cone is a hole into which fits a fairly large cork or bung. The chloroform is poured on to a sponge loose inside the mask and the cork inserted. More chloroform is inserted as necessary by the removal of the bung. It appears to me that by this method and the Carlisle method the result is attained by partial asphyxiation, a course open to grave objections from the humanitarian standpoint, and causing great distress to the patient in the early stages of the procedure.

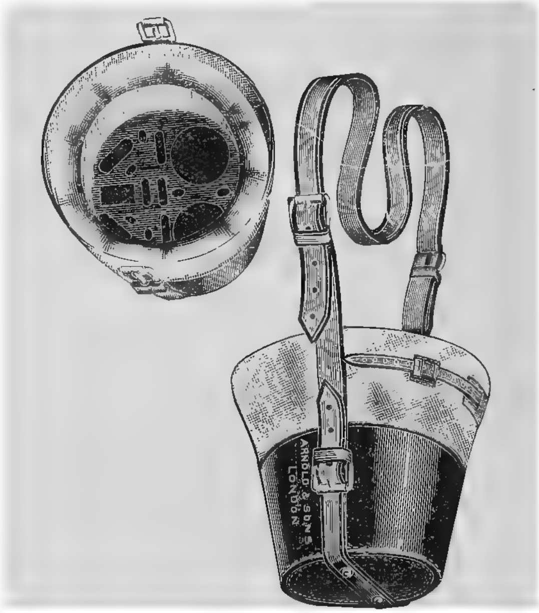


Fig. 213.—Nelder's chloroform inhaler.

(*d*) The muzzle introduced by Mr. Nelder of Exeter appeals to me as being the best of all. It consists of two portions; the one placed first over the lower end of the face is cylindroid and made of tarpaulin, and to its upper border is fitted a bolster, which can be drawn tight and so prevent the entrance of air from above. It is fastened over the poll by means of a strap. The lower end is closed by a disc of leather much perforated, through which respiration takes place. A deep leather cap is made to fit over this, and is held to the former portion by straps and buckles. It holds a circular piece of felt or a sponge on to which the chloroform is poured, and when in position this is held against the perforated disc of the muzzle. All air passes between the two portions and over or through the sponge, and the amount of air is regulated by the closeness or otherwise of the outer portion to the inner by tightening the buckles or relaxing them. In no case should it be drawn quite tight, since partial asphyxiation should be avoided. I consider this to be the best chloroform muzzle for a horse for administration either standing or in the recumbent position.

(*e*) A modification of Junker's method has been applied by Sheather, Hoare, and others to the horse. It consists of driving air by means of a foot-bellows through chloroform in a flask and on into the mask applied to the face. This is probably the most scientific method, for in this way the amount of chloroform vapour being inhaled can be most easily controlled. It is, however, by far the most laborious method, and since the horse is such an excellent subject, such a nicety of concentration or dilution of the chloroform appears to be quite unnecessary, and, taken as a whole, the method is not as satisfactory as some of the others. I have also seen a horse asphyxiated by this method.

Horses and cattle are usually cast with hobbles for the administration of chloroform, and all undue pressure on the throat and chest must be avoided. In each case the head must be kept fully extended during the administration of the anæsthetic. The objects of this precaution are in the first place to permit of free respiration, and in the second place to reduce the power of the patient when attempting to struggle in the excitement stages and causing such severe injuries as fracture of the spine or one of the limbs. The amount of chloroform to commence with must depend upon the size of the patient, and varies from ℥ss. to ℥i. in the larger breeds. This quantity should be poured on to the sponge and inserted into the muzzle, and the end of the muzzle closed in order to limit the amount of air admitted. Further amounts of ʒii. to ʒiii. at a time should be applied to the sponge as required. With good subjects, if the chloroform is administered without waste, ℥i. to iss. is sufficient to anæsthetize the horse in about ten minutes, and a total of ℥ii.-℥iii. will keep him well under for half an hour or so. By cautious administration, however, a horse may be kept sufficiently under chloroform for several hours. In England it is a common practice to exclude air as far as possible in order to expedite the anæsthesia. The writer, however, does not entirely agree with the practice. He admits that anæsthesia is more quickly obtained by this means and that it is more economical of chloroform, but it is at the expense of partial asphyxia. He prefers to allow more air and to use more chloroform. He considers this procedure safer, and is of opinion that horses recover more quickly from the effects of the anæsthetic. Some horses appear to be very resistant and practically immune to the anæsthetizing action of chloroform, and the writer has met with cases in which ℥xiv. and ℥xvi. respectively were administered without producing anæsthesia.

The Administration of Chloroform standing.—Chloroform may be administered to horses in the standing position if there is plenty of room. This method has some advantages over the method of administration in the recumbent position, and may be advocated in the case of very refractory horses that are difficult to cast, and also in the case of some old horses with anchylosis of the spine, whose back might be injured if cast in the usual way. The injury to the back, however, is usually due to violent muscular contractions while under restraint, and is rarely or never brought about by the act of casting. If properly administered by this method many horses submit very quietly to the process, but others become somewhat violent, rearing and plunging, and may even fall over backwards. If done in a large loose-box or operating theatre the horse may also get down in a corner in a very awkward position.

The best method of procedure consists in putting on a strong head-stall or caveson and then placing the chloroform muzzle on the horse's head while in his loose-box. As he can breathe freely through it he does not seriously object. The animal is then led out into the paddock or operating yard and the chloroform, from ℥iss. to iii. according to the size of the horse, is poured over the sponge, or felt in the case of Nelder's muzzle. The end of the muzzle is then closed. The patient may be kept moving in a circle, but should be allowed to do so more or less voluntarily and should not be unduly restrained, otherwise he is likely to show fight. Nelder frequently administers ℥i. of chloroform while the patient is still free in his stable before being brought out, and an additional ℥i.-℥ii. when the horse is brought out. It is sometimes an advantage to strap up one fore-leg in order more easily to control the movements of the horse. In a good subject, in about five to ten minutes the patient sways a little from side to side, staggers a little, and either gently falls down or may be pushed over. When the horse goes down the stage of excitement is over, and as a rule it takes very little more chloroform to render anæsthesia complete. The hobbles can then be placed on the horse quite easily, although if the anæsthetic is continued it may be unnecessary to resort to this restraint, depending upon the operation about to be performed.

For chloroforming horses in the standing position in a little space, Male secures the horse by means of a caveson and a long rope, which is passed twice through a ring in the wall about the height of the horse's head. An attendant holds the rope firmly, well out of the horse's reach in case he should fight. In such a case, however, the horse soon realizes the futility of struggling, and as in the other method of administration standing, he soon goes down or can be easily pushed over. Since the rope passing through the ring is not tight it can be quite easily relaxed or released if and when necessary. Male sometimes applies the casting side-lines to the horse with the rope above the hocks before administering the chloroform, so that when the horse goes down he can be quickly secured. (See "Restraint.")

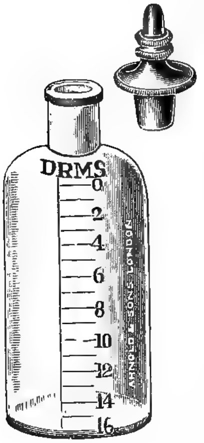


Fig. 214.—Chloroform drop-bottle.

Dogs and Cats.—Chloroform is best administered to dogs stretched in a prone position on the operating table; collars should be removed.

The simplest apparatus consists of an ordinary wire muzzle and over it a towel, which should be only one layer thick, and to which the chloroform is applied by means of a drop-bottle. This method is only safe for large and adult dogs, care being taken to allow plenty of air, and not to be too free with the chloroform.

Fig. 215.—Chloroforming a dog.

Another very simple and effective method is to pour chloroform on to a piece of lint or wool contained in a chip-box or galley-pot and held over the nose. By this method there is an unlimited supply of air, and although it has the appearance of a rough-and-ready method, it has much to recommend it.

Junker's apparatus is good for strong and large dogs. It consists of a cone-shaped mask with an open apex. This is placed on the face, and by means of a pump or bellows air is driven through chloroform in a bottle and, thus saturated, is passed on into the muzzle. On passing through the bottle the air takes up about 2 per cent of chloroform. By means of one's hand at the open apex the amount of fresh air may be regulated and further dilution permitted, or otherwise.

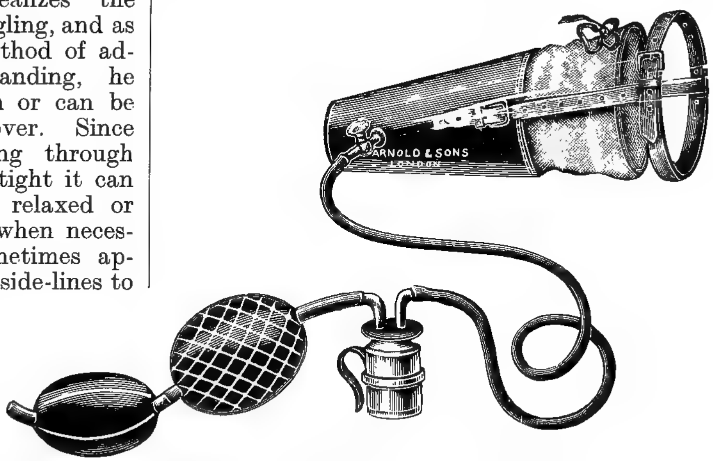


Fig. 216.—Hobday's inhaler. No. 1 pattern.

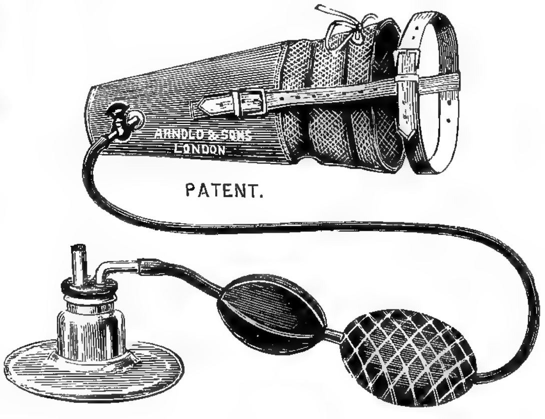


Fig. 217.—Hobday's inhaler for small animals. No. 2 pattern.

Hobday has introduced two modifications of Junker's method, both leading to much greater safety for smaller dogs and for cats. By one method air is driven by means of a double rubber bellows over chloroform and on into the mask. By the other method the pump is placed between the flask containing the chloroform and the mask, and air is drawn over the chloroform and passed on into the mask. This latter method is the safest for very small dogs and for cats, as the chloroform vapour is so very dilute (1 : 1000 to 1 : 5000), so much so that the method is useless for larger dogs and must be supplemented with additional chloroform on wool placed in the mouth of the mask. The pump is of rubber, and has an elastic reservoir and a stop-tap at the mask to regulate the flow and to get a continuous current of air and chloroform vapour. The manipulation of the pump is rather fatiguing in prolonged operations, and to overcome this objection Hobday introduced a small portable electrical apparatus to pump air over the chloroform.

The secret of success, by whatever method chloroform is administered, is the slow but continuous administration and the removal of all restraint to free and easy breathing.

Symptoms of Chloroform Anæsthesia.—The effect of the inhalation of chloroform vapour can be observed as occurring in four stages, namely: (1) the excitant; (2) the narcotic; (3) the anæsthetic; and (4) the paralytic stage.

In the *excitant* or stimulant stage the first effect is a vigorous struggle of alarm, and that is quickly followed by excitation of the cerebral and cardiac functions. The pupil becomes dilated, the pulse and respiration are accelerated, and fæces and urine are often passed. Vomition, even in the dog and cat, is very rare.

This stage may last from one to five minutes, but it is markedly shortened if the patient has previously received morphia hypodermically, or chloral hydrate by the mouth. It is not entirely without danger, especially in cases of cardiac affection, as the excitement may cause arrest of the heart's action, and attempts at restoration are rarely effective. Another danger is that in some cases where the chloroform has been administered in a too concentrated form the respiratory centre may be over-stimulated, and respiration may suddenly cease even before the patient has reached the anæsthetic stage. In patients with a normal heart, however, this first stage gradually merges into the second or narcotic stage. In this stage, generally reached within five minutes, there is great depression of the motor centres and the voluntary muscles become relaxed, commencing at the hind limbs. In the recumbent horse struggling ceases and the tail becomes relaxed. If administered standing, the horse becomes unable to support himself, staggers and falls gently, or is easily pushed over. In the dog and cat secured in the prone position the head sinks to the table and there is often a slight whimpering as though the dog were dreaming. In each case the reflex functions are only dulled, and sensibility is not completely lost. This is a useful stage for controlling labour pains in cases of difficult parturition in both large and small patients, and also for minor operations. In the third, or *anæsthetic stage*, there is complete muscular relaxation and complete loss of consciousness. Reflexes are lost entirely, pupils slightly contracted. The pulse and respiration become slower, even and regular. This is the true surgical stage, and if the chloroform is continued very slowly it can be maintained for an hour or two with perfect safety, since none of the vital nerve centres of the medulla, such as those controlling respiration and the action of the heart, are seriously affected. If, however, the chloroform be administered at this stage either copiously or with very limited admission of air, then a dangerous *paralytic stage* is produced owing to the medullary centres becoming involved. The pupils become widely dilated, while the respiration becomes shallower and stertorous, irregular and jerky, and may suddenly cease. The pulse gets slower and weaker, but the heart may continue to beat several minutes after respiration has ceased. In such cases, if the chloroform is quickly stopped and plenty of fresh air admitted, respiratory stimulants and artificial respiration resorted to, breathing is generally resumed. In some cases, however, if the chloroform has been pushed too far, the respiration cannot be restored, and death occurs from asphyxia. In other cases the heart's action may cease simultaneously with or even before the respiration, and in my experience such cases have resisted all restoratives and have always proved fatal.

In the Hyderabad experiments of 1888–9 it was clearly demonstrated that when lethal doses of chloroform were administered to healthy animals respiratory arrest always occurred from two to six minutes before cardiac arrest. This confirmed what was previously taught by Simpson, that the careful observation of respiration is of paramount importance for safety in chloroform anæsthesia. Consequently anything with a tendency to impede respiratory functions must be studiously avoided, as already indicated. The anæsthetist must see that the anæsthetic is being admitted slowly and regularly, and he must keep a watchful eye on the character of the respirations. He should not concern himself with the work of the surgeon, however interesting it may be, for the chloroform must be withdrawn at the first indication of danger. The anæsthetist must remember that the work of the surgeon, however skilful, is of no avail if the patient should succumb to the anæsthetic.

The *signs of danger* may be summed up shortly thus: Shallow spasmodic or jerky breathing, stertor, cessation of respiration, intermittent pulse, and widely dilated pupils. In the dog and cat also the coat may be seen standing up and even turning the wrong way.

Antidotal or Restorative Treatment.—At the first indication of danger the chloroform should be stopped and the inhaler removed, together with all obstructions to free respiration. The tongue should be pulled forward in the mouth, and mucus and saliva mopped out. Remove hobbles and admit plenty of fresh air, or even oxygen if at hand. Then administer as quickly as possible a full medicinal dose of hydrocyanic acid (of 2 per cent or B.P. solution for horses, ʒi., and for dogs and cats 2 to 5 minims). It may be dropped on to the dorsum of the tongue or injected hypodermically. It acts as a powerful and rapid, though transient, stimulant to the respiratory centres, and in the writer's experience is far the best restorative agent.

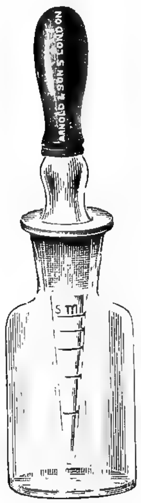


Fig. 218.—Drop-bottle for hydrocyanic acid.

Artificial respiration should also be resorted to. This consists of rhythmically contracting and expanding the chest by jerking pressure on the chest wall and by alternately extending and flexing fore limbs. Peripheral irritation may also be good, such as a cold douche or flicking with a wet towel or a whip.

The cautious insufflation of strong ammonia is good as a cardiac and respiratory stimulant. Amyl nitrite may be useful by dilating superficial vessels and so relieving the heart. It may be either insufflated, or dropped on to the tongue, or injected subcutaneously in doses of 10 to 20 minims for the horse and 1 to 2 minims for the dog. Hypodermic injections of ether, liquor strychninæ, adrenalin, may all assist.

In favourable cases respiration starts with gasps in from one minute upwards, and hope should not be abandoned until the artificial respiration has been continued at least fifteen to twenty minutes, or so long as the heart beats, be it ever so feebly. If, however, the heart's action completely stops, the case is usually hopeless.

How does the Chloroform produce its Effects?—Very exhaustive experiments in this connection have been carried out by Dr. G. A. Buckmaster and his co-worker J. A. Gardner, and their results are published in the *Proceedings of the Royal Society*. They have shown that the effects of chloroform anæsthesia depend upon the exchange of gases in the pulmonary alveoli and blood, and that the red corpuscles alone act as the chloroform carriers. In the early stages the absorption is very rapid, and less so later on. The red corpuscles convey it to the various parts of the body, and discharge certain small amounts to the tissues, and especially to the central nervous system. The first effect of that is to stimulate the nerve centres, and this stimulation may even approach a lethal value constituting the first danger point previously referred to. It may cause cessation of respiration owing to paralysis of the respiratory nervous mechanism, and is more likely to occur as the result of a deep and rapid respiration and a higher percentage of the drug administered. If this stage is safely passed, the cerebral centres become depressed and complete anæsthesia may be attained safely. If the chloroform is continued in high dilution, elimination takes place by expired air and an equilibrium is established. If, however, a larger quantity of chloroform is rapidly administered, it gets into the plasma, and is co-existent with a decidedly dangerous stage in which the respiratory centre is over-depressed and breathing stops.

The facts that in respiratory chloroform anæsthesia the red corpuscles transport the drug and that chloroform is not present in the plasma except in dangerously advanced stages, would appear to explain the lack of success following the attempts to produce anæsthesia by the intravenous injection of chloroform. In the opinion of the writer such a method, though worthy of further investigation, does not appear very promising.

After-treatment and After-effects.—When the operation is about completed the chloroform inhaler is removed, but in the horse the hobbles should be kept on until consciousness has fully returned. It is a mistake to allow a horse to attempt to rise until there is a reasonable prospect of his being able to support himself. The time required may be from five minutes to half an hour, or occasionally even longer. If a horse has been lying long on the one side, the writer has frequently noted that he is likely to rise more quickly and is more able to support himself if he is turned over on to his other side a few minutes before he is allowed to attempt to get up. If after a reasonable interval he does not make any effort to rise, he may often be induced to do so either by flicking with a wet towel or a whip, or by pouring a little water into an ear. When rising he should be supported by an attendant with a short hold of the bridle, and another attendant at the tail. He should then be kept slowly moving with his head to the wind until he completely gains his equilibrium. He may then be put into a loose-box, but should not be secured by the head in case he should fall again. About an hour later he may be offered a drink of tepid water or oatmeal gruel, mashes being offered later. During the first day dry foods and long hay should be withheld.

In the case of the dog he should be placed quietly into his apartment and only offered a little milk or a little tepid water for the next few hours. Sometimes the patient will only feed capriciously the next day as the result of nausea, but this condition rarely lasts longer.

Unfavourable sequelæ to chloroform in our patients are very rare. Occasionally a nostril may be blistered when a sponge has been applied to an imperfectly lubricated nose. Pneumonia is sometimes spoken of as being a sequel, but the writer, in an experience involving the use of chloroform in many thousands of cases, has never met with pneumonia directly attributable to chloroform.

Ether compared with Chloroform as a General Anæsthetic

Ether is more disagreeable to the taste and causes a much larger increase in salivation than chloroform. The preliminary stage of excitement is longer and the anæsthesia more transient. On the other hand, it is less dangerous, owing to its less depressant effects. Therefore it is safer to use on patients with weak hearts, and young or fat patients. It must, however, be administered in a much more concentrated form as half ether vapour and half air, conditions which make it very difficult to use for large animals.

A.C.E. mixture and A.E.C. mixture occupy intermediate positions between ether and chloroform.

In the writer's experience, however, chloroform is by far the best agent for the production of general inhalation anæsthesia.

The Combination of a Narcotic and a Local Anæsthetic

The application of respiratory anæsthesia has the disadvantage of requiring a trained anæsthetist as well as the operator, and owners frequently refuse to pay adequately for such services. A common alternative is for the operator to administer the chloroform and direct it at the same time as operating; an objectionable alternative for obvious reasons.

Consequently, for dogs the writer very frequently dispenses with chloroform and employs a large dose of morphia, with or without the addition of a local anæsthetic according to the case. The dose, injected hypodermically, varies from $\frac{1}{3}$ grain, in a puppy of the toy breeds, to 2 grains or even 3 grains for adults of the large varieties. After such injection the dog usually vomits in from one to five minutes, and sometimes fæces and urine are evacuated. Narcosis is complete in about three-quarters of an hour, when the operation can be proceeded with. One great advantage of this method is that the dog remains in a state of stupor for eighteen to twenty-four hours, and so refrains from interfering with the operation wounds. For major operations involving the peritoneal cavity a few whiffs of chloroform may be necessary, but great care must be taken, as the excitant stage is practically non-existent and complete anæsthesia is very rapidly produced with a minimum of chloroform.

Chloral hydrate, administered *per os*, or injected into the peritoneal cavity in dogs, has not given such satisfactory results in the writer's experience.

The use of morphia and of chloral hydrate in the horse have also been disappointing, and we have not persisted with them, mainly because we have always found the horse to be such an excellent subject for chloroform.

G. H. W.

SURGICAL TECHNIQUE

Asepsis is the method of rendering the free surfaces and the deeper tissues of the body, the hands of the operator, the instruments, sponges or swabs, and the suture and dressing material he is going to use in an operation in a sterile condition; that is, free from obnoxious micro-organisms which, if they gain entrance into wounds, multiply, produce toxins, and cause inflammation and its consequences, such as suppuration, necrosis, or septicæmia. It also includes keeping the operation wound free from pathogenic microbes and the removal of the media for their development until the tissues have undergone complete repair. It implies not only that bacteria must be destroyed on the free surfaces, but they must not be introduced into the wounded tissues by the surgeon's hands, instruments, sponges or swabs, sutures or dressings.

Asepsis is carried out by sterilization of the tissues and the surgical appliances and materials by means of heat and with the aid of chemical agents that have the reputation of destroying bacteria or retarding or preventing their development.

Although the process cannot be carried out successfully in veterinary surgery, owing to the unfavourable surroundings of our patients and the lack of trained assistants, it may be partially adopted as regards instruments, dressings, water, and certain of the suture materials, which can be sterilized by boiling them for twenty to thirty minutes. It is, in fact, a valuable adjuvant to the antiseptic method, which is more applicable in operations carried out on our animals.

Antisepsis is the method of preventing infection of wounds and the mitigation and destruction of infection, should it arise, by means of antiseptics or those chemical agents endowed with the properties of retarding the development of micro-organisms which set up suppuration, gangrene, septicæmia, and other wound infections.

It was instituted in 1865 by Lister, who, inspired by the labours of Pasteur on fermentation, established the germ theory of wound infections. By this antiseptic system he was able to reduce the mortality of major operation and other wounds from 50, 60, and more per cent to 6 and even 4 per cent. Until this era a great number of surgeons believed that the bad nature of wounds was due to a vitiated state of the atmosphere in hospitals, which they considered was charged with the miasmata of putrefaction. The work of Pasteur and of Tyndall seemed to confirm the correctness of this view by demonstrating that it was not the air itself, as many surgeons of former times thought, but the germs which floated in it that were endowed with injurious properties. Lister himself was at first a believer in the danger of aerial micro-organisms gaining entrance into wounds, and to obviate their obnoxiousness he introduced the disinfecting spray, which he ultimately abandoned. Although Lister was not the first to use antiseptics in the treatment of wounds, he was the pioneer of using them in a methodical manner with a definite object in view—that of destroying the micro-organisms which cause wound infection.

In 1870, A. Guérin introduced cotton-wool with the object of excluding germs from wounds, paying little attention to infection of instruments, dressings, and the hands. Nevertheless he always washed his hands and cleansed the site with soap and spirit of camphor before commencing an operation. He applied several layers of cotton-wool and firmly maintained them in position by means of a bandage, which he thought checked secretion and thus prevented infection. If the secretions were so profuse that they saturated the bandage, he added fresh layers of cotton-wool to those already in position.

Lister's practice was to destroy the aerial micro-organisms by spraying the air with a strong solution of carbolic acid in the neighbourhood of the wound—those deposited on the wound, on the surgeon's and assistant's hands, on instruments, sponges, compresses, ligatures, and dressings. After the wound had been freed from infective germs it was covered with a protective dressing, impregnated with carbolic acid or some other antiseptic agent, and precautions were taken against the accumulation of serosity from the divided tissues. As germicides Lister chiefly used a 5 per cent solution of carbolic acid or a weaker one of 2½ per cent. With the former he disinfected the instruments, sponges, and the operation area, and also, after finishing the operation, the crevices of the wound. The weaker solution he used for washing his hands and those of his assistants, soaking the sponges and cleansing them during the operation. Before and during the operation and until all hæmorrhage had been arrested by ligaturing with catgut cut close to the knot, the lips of the wound approximated by sutures of the same material, drains fixed to allow the escape of serous discharge and dressings applied, the spray containing a 5 per cent solution of carbolic acid was allowed to play on the operation area. This area was then covered with a fine layer of oiled silk with the object of protecting the skin and wound against the irritating effect of carbolic acid; above this were placed eight double layers of carbolized gauze, the two last layers of which were separated by a layer of mackintosh to prevent the evaporation of the carbolic acid and to cause the serosity from the wound to permeate the whole extent of the dressing before reaching the outside layers. At the end of twenty-four to forty-eight hours, if this protective dressing became saturated with an abundance of serosity resulting from the irritation set up by the intense chemical action of carbolic acid, it was removed so as to examine the wound and the state of the sutures and drains and, if necessary, to replace it with fresh dressing after the wound had been irrigated with the strong (5 per cent) solution of carbolic acid—all performed under the carbolic spray.

Recent wounds with more or less spaces in them were washed with a 10 per cent solution of carbolic acid before the protective dressing was applied. Suppurative wounds, cavities, or sinuses were curetted and then cleansed with a 10 per cent solution of chloride of zinc, but no protective dressing was applied to them. Such were the earlier methods adopted by Lister in carrying out his antiseptic system; but as time went on these were modified by him and his followers, so that now the spray is dispensed with and wounds are no longer submitted to the irritating effects of strong antiseptics, but in their place weaker solutions are used with the object of retarding the development of bacteria when it is not possible to exclude them altogether by surgical cleanliness and a well-maintained protective dressing.

Although the strict antiseptic method in combination with the aseptic is capable of realization in human surgery, especially when carried out in large institutions with all the necessary appliances, it is difficult to carry out in veterinary practice because of the lack of suitable surroundings and of skilled assistants, and owing to the refractoriness of our patients and the conditions under which they live. On the other hand, it is not so necessary, because under the majority of conditions our patients are less subject to those influences which in man increase the chances of becoming infected with virulent micro-organisms derived from other infected wounds. Also, the majority of operations are carried out on young and vigorous animals whose wounds, as those of castration, are left unprotected with a wide dependent orifice which affords efficient drainage. The danger of infection of wounds in animals mostly is dependent on the wounds getting infected from the soil, such as gangrenous or gaseous septicæmia and tetanus rather than from infection derived from other infected wounds.

Nevertheless asepsis and antisepsis should be carried out as rigidly as is possible in general practice, more especially when dealing with wounds penetrating the chest, abdomen, joints, tendons or their sheaths, cartilage and bone in the horse and wounds in general in sheep and in the cat, the three animals most susceptible to the bad influences of wound infection. The pig, ox, goat, dog, and fowl are more immune to infection, but notwithstanding this fact surgical cleanliness and antisepsis should be carried out as a matter of routine in these animals as in the more susceptible species.

The Choice of an Antiseptic.—An antiseptic should be chosen on account of its sterilizing influence on micro-organisms suspended in blood-serum, pus, exudations, and devitalized tissues; its power of penetration and its comparative harmlessness to the living tissues. It also should be relatively non-toxic if by chance some of it should be absorbed into the system. It by no means follows that because a certain chemical agent will destroy microbes suspended in water in a test-tube it will have the same effect when it comes in contact with them when immersed in the exudates and discharges of a wound. On the other hand, some chemical agents have very little neutralizing effect on bacteria in a culture medium in a glass tube, but have great influence on them when living in the animal body, as, for instance, the action of iodide of potassium in actinomycosis and of quinine in malaria.

The results obtained by the use of antiseptics in the treatment of wounds depend rather upon the method with which they are used than on the agent selected.

Antiseptics are chemical agents which have the property of preventing or retarding the development of microbes. Some microbes, although they may not be destroyed by such agents, are so altered in physiological action that they become quite harmless. In minute quantities disinfectants and germicides may act as antiseptics, but many antiseptics have very little if any germicidal action, and in consequence they are either unreliable or useless as disinfectants.

Carbolic acid is one of the best-known antiseptics, and although used in rather a haphazard manner by certain surgeons before Lister employed it in a methodical manner and with a definite object, the credit of demonstrating its properties is due to Lister. Although it may not be one of the most powerful antiseptics it still holds its position in practical surgery, especially in the treatment of operative wounds, for sterilization of the hands of the operator and those of his assistants and of the operation zone, and also for the disinfection of instruments, ligatures, and dressings. For these purposes the pure crystallized acid, which should be rendered liquid by the aid of heat and the addition of about $\frac{1}{20}$th of its bulk of water, should be used, diluted with 20, 40, or 50 times its bulk of water, to which may be added 1 to 2 per cent of methylated spirit. The 1 in 20 or 5 per cent solution should not be used on recent operative wounds, on which it would have too much of an irritative effect; nor should the hands of the operator be immersed in it, as it produces a numbing sensation, which impairs the sense of touch. It should be reserved for the immersion of instruments, sponges, swabs, ligatures, and dressings, for the cleansing of the operation area before the skin is incised, and for the cleansing of wounds that have been exposed to the air or become foul. It is also used to set up a slight adhesive inflammation in the close vicinity of the sutures in abdominal surgery. It should not be kept long in contact with those parts of the skin which are very sensitive, as it is liable to cause vesication. If it should cause too much irritation it should be speedily removed by washing with methylated spirit. The 1 in 40 or 2½ per cent solution is suitable for sponges or tampons, with which the wounds are freed of blood by gently wiping it away from the tissues. Before these are used for such purposes they should be well squeezed so as to remove as much of the antiseptic fluid as possible, as too much irrigation, washing or wetting of recent wounds sets up irritation in the tissues, producing much serum and preventing union by first intention. It is also useful for rinsing the hands, instruments, etc., from time to time during an operation. The 1 in 50 or 2 per cent solution is antiseptic in action, but beyond this dilution it loses this power.

Carbolic acid is a solvent for iodine, and in this combination acts as a powerful but painless escharotic on new growths with ulcerating surfaces, chronic sinuses, especially those on the coronet and in actinomycosis. When used pure and highly concentrated it is not only escharotic but is also hæmostatic, sealing small blood-vessels and lymphatics, hence its absorption does not take place and intoxication is thereby prevented. Mixed with 10 to 20 parts of olive oil it forms carbolized oil, which is useful for smearing on painful superficial wounds and burns and also on the arms and hands in difficult cases of parturition.

In canine and feline practice, carbolic lotions must *not* be applied too freely nor over too large a surface, for fear of intoxication by absorption, to which dogs and especially cats are very prone. Should such a deleterious effect be produced, sulphate and carbonate of sodium or magnesium should be administered.

Lysol, as well as many of its imitations sold under various names, is a preparation obtained by the saponification of one of the tar oils with an alkali, and is said to contain about 50 per cent of cresols. Adam, of Alfort, recommends a similar preparation which is made by adding 1 part of cresol to 1 part of soda lye of 30 per cent and having a density of 1332, this readily dissolving without heat. It is a dark brownish syrupy liquid, which forms with distilled water a clear solution without leaving any deposit, but with ordinary water it forms a solution which after some time becomes turbid and eventually throws down a sediment. In veterinary practice it is almost an ideal antiseptic, as it is not only cheap but is also efficacious. In consequence of its saponaceous qualities it forms an excellent detergent for the hands, preparing the greasy skin for an operation, and for loosening adherent dressings from wounds. It is also a reliable agent for the disinfection of instruments, sutures, dressings, and infected wounds. Instruments submerged in it for several weeks keep free from tarnish.

For operative wounds a 1 per cent solution is an efficient antiseptic ; beyond this strength it is liable to set up irritation and cause the outpouring of serum, which is inimical to reparation by first intention. It is advisable not to irrigate freshly incised wounds with this, but use a sponge or a piece of lint or a tampon of cotton-wool encased in a coating of gauze which has been immersed in the solution and then well squeezed out to wipe gently away the blood from the wound cavity. In a strength of 0·5 per cent it forms a reliable antiseptic for irrigation of the uterus of the larger animals after difficult parturition or after abortion, care being taken that the retained solution is syphoned off from the uterine cavity. Instruments, suture material, and surgical dressings, after they have been sterilized by boiling, should be immersed in a 5 per cent solution until they are required for use, when they should be transferred to a 2½ per cent solution, into which the hands and instruments should be plunged from time to time during the operation. The 5 per cent solution has a benumbing action on the hands ; it is a reliable detergent and disinfectant for foul wounds and for the feet. It is an excellent agent to remove blood from the skin and coat after an operation, and for shepherds to wash their hands in during the lambing season, to apply to the navel and, in the castration and docking season, to the scrotal and tail wounds.

Although it is relatively less poisonous than carbolic acid it should not be used as a uterine irrigant nor applied over too large a surface of the skin in canine and feline practice. Adam's preparation is used 1 in 100 to 400 of water as a disinfectant and antiseptic.

Cofectant, according to the *Lancet* Commission, has the highest carbolic acid coefficient. It is composed of phenols, phenoloids 66·27, resins with fatty acids 24·66, water 6·4, potash 2·67 per cent. It is an efficient disinfectant even in 1 per cent solutions, and is particularly useful in foul wounds in the larger animals. **Creolin** and **Izal** are cheap and reliable disinfectants and antiseptics. The only objection to these three agents in veterinary practice is that they form, with water, emulsions which hide instruments and dressings immersed in them from the view of the operator. As they are relatively cheap they are suitable for surgical operations on the feet and for the disinfection of foul wounds in farm animals.

Mercury perchloride or sublimate is a powerful antiseptic. The researches of Koch and others have demonstrated that 1 in 1000 solution kills the spores of anthrax in fifteen minutes, and the bacilli themselves are killed by 1 in 15,000 in one minute. The development of the same bacilli is prevented by 1 in 500,000. Solutions of 1 in 10,000, 2000 or 1000 have been used in general and ophthalmic surgery, and for cleansing the operation zone of skin or mucous membrane and for washing freshly-incised wounds and the hands. It may also be used for irrigating abscess cavities. To get the best results it should be freshly prepared and used hot, as it is more active in a weaker solution when used hot than when used in a stronger but cold solution. Concerning the treatment of suppurating wounds, the wound must be washed daily with a warm 1 in 2000 solution and the part dressed with as much care as if non-infected, when in a short time the discharge of pus will gradually cease and the wound remain clean and sweet. It should not be injected into cavities nor into the uterus, as it is rapidly absorbed and likely to set up intoxication.

It is used for the sterilization of the hands, catgut, and other organic suture material, and dressings. It is unsuitable for the disinfection of instruments, as it destroys the metal and blunts the cutting edge.

One of the objections to its use is that it forms an albuminate with the albumin of the tissues and fluids of the body with which it comes in contact, and is therefore rendered inert as an antiseptic. This is, however, obviated by adding tartaric acid, sodium chloride, ammonium chloride or hydrochloric acid to the solution containing it. It will not act efficiently on a greasy skin and is incompatible with alkalies and their carbonates, soap, iodine, and some metallic salts. On some people it causes irritation of the hands. It is also liable to produce irritation of wounds and thereby hinder the reparative process.

Some authorities use alcohol instead of water as a solvent. One part of sublimate in 500 parts of alcohol 90 per cent is used as a disinfectant for the hands and skin, but there are many safer and just as effectual agents for this purpose with fewer drawbacks. Lister and Watson Cheyne recommend 1 in 500 sublimate with 5 per cent of carbolic acid added for cleansing the field of operation, a foul wound, and the hands. Mercury perchloride is used in its pure state in the form of a pencil for plugging sinuses of the coronet, poll, and withers, with the object of destroying the wall of the sinus and setting up repair by granulation. It is also used in the form of a liquor (sublimate 1 part, camphor 1 part, and spirit 10 parts) for injection into quittors, and as a paint for the skin covering articular and periosteal exostoses, as in spavin and splint.

Lint, absorbent wool, gauze, and wood-wool are impregnated with 0·5 per cent of corrosive sublimate and coloured with methyl blue and used as absorbent or protective dressings in the antiseptic treatment of wounds.

Mercuro-zinc cyanide gauze containing 3 per cent of mercuro-zinc cyanide was introduced by Lord Lister as a dressing applied direct to wounds. It has the advantage over other mercurial dressings of being less irritating and keeping well without becoming reduced by the cottons. Wood-wool and gauze bandages containing 3 per cent of the same material are also prepared.

Mercury biniodide has more powerful antiseptic properties than sublimate and is less irritating. When used as a solvent, potassium iodide forms with it a double iodide of mercury and potassium—potassio-mercuric iodide. It does not coagulate albumin and therefore does not cause precipitation of the blood. Besides being less irritating to wounds it is less irritating to the hands and is far more penetrating and less toxic. It may, when iodide of potassium is added as a solvent, be incorporated with soap, either in a liquid or solid form, as a disinfectant for washing the hands and the operation zone.

For wounds 1 in 2000-4000, and as an antiseptic for irrigating the conjunctival sac 1 in 10,000, may be used.

Zinc chloride is a very powerful antiseptic and deodorant, but unless used in a very weak solution is only suitable for neglected or necrotic wounds on the lower part of the limbs of the horse. In these cases it is superior to any other agent, and when used as a 10 per cent solution to treads and other necrotic areas, usually at the front or sides of the skin covering the coronary region, it not only destroys the fœtor of such wounds but prevents the necrotic process extending to the deeper tissues. It thus renders a septic wound aseptic. In this strength it is useful as an injection for quittors and other chronic sinuses. Applied as a lotion of 1 in 20 to recent and also chronic collar and saddle abrasions or ulcers it acts not only as an antiseptic but also as an astringent.

It should not be used as an irrigant in deep wounds in soft tissues, as by having a very powerful astringent effect, even when applied in a very weak solution, it hinders the reparative process.

Burnett's Fluid (an impure concentrated solution of zinc chloride) diluted with five to twenty times its bulk of water is a very efficacious antiseptic deodorant, and astringent in the treatment of grease. It should be applied with brisk friction every two or three days until the desired effect is obtained.

Potassium permanganate, besides being a disinfectant and one of the best deodorants, is also a very good antiseptic. In a one or two per thousand solution it forms a useful disinfectant and antiseptic for the hands, and mucous membranes of the mouth, nostrils, uterus, and rectum. It is also a good antiseptic for cleansing the skin prior to an operation and for disinfecting septic wounds and cavities. A 1 per cent solution injected thoroughly into the depth of a snake-bite as soon as possible after its infliction is a certain antidote. Injected into the uterus after a bad parturition or in prolonged retention of the afterbirth, a solution 1 in 500-1000 destroys all bad odours. It should be injected at a temperature of 100° to 105° F. at least. This or a weaker strength is also suitable for disinfecting the conjunctival sac prior to an operation on the eyelids or eyeball. In a powdered form it may be used as a powerful disinfectant in necrotic wounds due to the bacillus necrosis on the limbs of horses.

Hydrogen peroxide is a feeble germicide and only a moderate antiseptic even against anaerobic microbes. It has no effect on the *Bacillus perfringens*. It acts more as a detergent than as an antiseptic, and in consequence it is suitable for cleansing the mouth, rectum, vagina, conjunctival sacs, nasal channels and sinuses, and the external ear. It has been used as an aid in determining the extent of an open abscess cavity by distending the lumen in order to enable one to find a safe place for making a counter-opening for drainage purposes. It is useful for loosening adherent bandages and dressings. Injected into sinuses, abscess cavities, and deep wounds it loosens the discharges and cleanses the cavities of debris. It does not precipitate albumin. It acts as an astringent in nasal hæmorrhage and a styptic in removal of polypi. It relieves wasp and hornet stings. Gauze in form of sheet or ribbon saturated with 5 per cent solution is useful for plugging cavities and wounds.

Aluminium acetate in the form of liquor aluminii acetici is known as Burow's Solution. One drachm of this liquor to the ounce of water forms an approximate 1 per cent solution, which is a good non-toxic, non-irritant, and astringent antiseptic for the prevention of the development of pus-forming bacteria. It is a valuable agent in the treatment of burns, infected wounds, and in cases where continuous irrigation of wounded parts is required for days or weeks. It is very good in the form of a fomentation for phlegmonous inflammation. It is a suitable antiseptic in canine practice. It is injurious to instruments and roughens the hands.

Lead subacetate and acetate are useful as sedative antiseptics in superficial inflammatory conditions and abrasions: they allay inflammation and check secretion. They may be used in conjunction with spirit. The writer has never observed by their use on dogs any injurious effects.

Formalin.—This is generally reputed to contain by weight 40 per cent of formaldehyde, but in consequence of evaporation during storage it rarely contains more than 35 per cent. In a 5 to 10 per cent solution it is invaluable in the treatment of grease, and in a 30 to 60 per cent solution, of canker. For this latter complaint it has been used in an undiluted state, but in consequence of its mummifying and penetrating action it has been known to dry up and destroy the whole of the soft tissues underlying the pedal bone so as to necessitate destruction of the animal. In its undiluted state, when carefully brushed on warts and ringworm patches, so commonly seen in young horses and cattle, it causes them to shrivel up or disappear. It has also been used for injecting into the centre of tumours and in the preparation of catgut.

Lysoform.—This is a liquid formaldehyde potash soap. It does not coagulate albumin and is miscible with water and alcohol in all proportions. It is used for the sterilization of surgical instruments, of the hands of the operator, and of the hoof and surrounding skin of the larger animals. For these purposes a 2 to 5 per cent solution, which does not produce numbness or irritation of the hands, is used. In 0·5 to 1 per cent warm solution not exceeding a temperature of 106° F. it may be used for irrigating the vagina, uterus, abscess cavities, and septic wounds. A 2 per cent solution has a styptic effect on wounds, and allays pain caused by bites, stings, and burns. In consequence of its powerful germicidal properties and of being practically odourless it is used for washing the udders of cows before milking, a process which sensibly reduces the number of germs in milk.

Methylated Spirit.—The mineralized or denaturalized methylated spirit is 90 per cent alcohol or rectified spirit, to which are added 10 per cent by volume of wood naphtha and $\frac{3}{8}$ths per cent of mineral naphtha or petroleum oil. Industrial methylated spirit is rectified spirit with 5 per cent its volume of wood naphtha.

It has long been used by many surgeons as an antiseptic to wounds. More recently it has been employed for cleansing the skin after it has been disinfected prior to an operation. Probably the good effects of spirit of camphor, friar's balsam, and the tinctures of iodine and calendula on wounds are partly due to the spirit they contain. Spirit is also used to remove an excess of carbolic acid from the skin before it has had time to produce a caustic effect, and in the cleansing of surgical instruments.

In pre-antiseptic days, spirit, especially camphorated spirit, was applied to wounds by means of lint saturated with it. Several layers were used, kept wet either by frequent douching or by covering with an overlapping layer of impermeable tissue, or by changing the dressing twice daily. It was also used as a lotion composed of 6 parts of absolute alcohol, $\frac{1}{2}$ part of liquor plumbi subacetatis, and 16 parts of distilled water. By itself, or containing 1 in 2000 parts of corrosive sublimate, it acts as a hæmostatic when applied locally by causing contraction of the capillaries. It is aseptic in itself.

Bismuth Subnitrate.—This is used in the formulæ of Beck's bismuth paste for injection into fistulous tracts, sinuses, and abscess cavities for X-ray examination and for curative effect. As a preliminary injection for diagnosis and early treatment 1 part of bismuth subnitrate is added to 2 parts of hot vaseline. This is injected by means of a glass syringe under aseptic precautions. The syringe is sterilized by dry heat, and the plunger dipped in sterile oil. For late treatment bismuth subnitrate 6 parts, white wax 1 part, soft paraffin 1 part, and vaseline 12 parts, and sometimes 1 per cent of formalin are mixed during boiling and injected with gentle pressure. As a precaution, no water but spirit 90 per cent must be used for washing the skin and orifice of the sinus. Bacteria are diminished in number after the injection, which acts partly as a bactericide, chemiotactic, and astringent, and partly by its mechanical action. The diseased walls of the sinuses separate by the stimulating action of the injected substance, which does not cause pain.

Bismuth subnitrate (8 ounces) is also used with double its weight of iodoform (16 ounces), and worked into the form of a paste with liquid paraffin (8 ounces or more according to requirements). This formula has been named " Bipp." It is well rubbed by means of dry gauze into the surface wall of a recently infected wound after this has been mopped out with methylated spirit. The superfluous paste is removed, and the wound is then sutured and covered with sterilized gauze and an absorbent pad. The dressing should be renewed if the wound does not progress favourably.

Chinosol is largely used as a mild antiseptic in veterinary practice. It may be used (1 in 1000 of water) for the hands, irrigating cavities such as the uterus, conjunctival sac, orbit after removal of the eyeball; wounds after the removal of necrotic tissue, as in those neglected wounds in dogs due to bites about the neck and shoulder. It is also a useful antiseptic for washing the conjunctival membrane before an operation on the eyeball.

Gauze impregnated with a 1 per cent solution forms an excellent material for plugging cavities. The powder mixed with kaolin or charcoal makes an effectual dry dressing for granular surfaces where the skin has been destroyed by necrosis.

Salicylic acid is a powerful antiseptic, but in consequence of its insolubility in water it is not used for the irrigation of wounds. It is chiefly used in the preparation of salicylic wool and gauze and sometimes silk. For superficial abrasions or granular surface wounds it makes an efficient dry dressing when mixed with kaolin and zinc oxide—a combination far superior in effect to that of iodoform. It is especially valuable in superficial wounds about the knees and coronets in the horse and in chronic auricular catarrh in the dog.

Boracic acid is an over-estimated antiseptic. Its reputed good effects are due rather to the hot water in which it is dissolved and applied than to the acid itself. It is suitable when used hot for irrigation of the bladder, conjunctival sac, nasal channels, and other mucous surfaces. It is used in the form of powder as a desiccant for granular wounds, and in catarrhal inflammation of the external ear. In the form of an ointment it is applied to ulcers.

It is used in the preparation of Dakin's Solution, and in the following paste: boracic acid 11 ounces, French chalk 1 ounce, liquid paraffin 8 fluid ounces, brilliant green 17½ grams. The boracic acid and chalk must be well mixed in a mortar and then the paraffin is incorporated. Afterwards the brilliant green is dissolved in spirit and worked up in the paste.

It is said to have given good results when thoroughly applied to every recess in a recently infected wound after the damaged tissues have been excised and the surface dried with a 1 per cent spirituous solution of picric acid.

Friar's balsam or the compound tincture of benzoin had long been used as an antiseptic before the advent of Listerism in the treatment of wounds, especially those complicating fractures of bones. It is useful in superficial wounds, and when applied sufficiently thick it makes a good protective. In compound fractures it is applied on a piece of lint which covers the wound; also to close the punctures in the skin after tenotomy. Evaporated to dryness over a water-bath and then mixed with collodion it forms a valuable means of retaining dressings on small wounds, such as those over the eyelids, face, knees, and on those caused by laparotomy in the dog and cat. It may be fortified by applying a finely-teased-out layer of cotton-wool, and then covering it with a second coating. It is a useful application to wounds in the mouth, or in the vagina, and as a hæmostatic, and when applied on gauze in the packing of cavities. It is used to mask the odour of iodoform. Tincture of iodine added to it increases its embalming or antiseptic qualities.

Terebene, oil of turpentine, oil of eucalyptus, and other essential oils, when mixed with a fatty oil to which carbolic acid or creosote is added, are very powerful and efficacious germicides and antiseptics when applied to putrid and suppurating wounds. They also repel flies and thus prevent maggots developing in such conditions in hot weather. They form a useful sedative and antiseptic application for burns.

Oil of cloves is a powerful antiseptic and germicide with local anæsthetic properties. It is used chiefly on wounds in the vicinity of joints as a styptic.

Iodine is one of the more powerful antiseptics, and has been in use for such purposes for upwards of a century in the treatment of septic wounds, fistulæ, and other surgical conditions. As a lotion in the form of 1 to 2 drachms of the tincture in a pint of water it has been used for irrigating operative wounds and the uterus after parturition and in metritis. Its specific action in the treatment of actinomycosis has long been established. In more recent years it has replaced washing of the skin and disinfection of the hands before an operation. For this purpose a 2 per cent alcoholic or petrol solution has been advised, but the B.P. tincture is equally good. Tincture of iodine made with methylated spirit causes irritation to the eyes of the operator and his assistants. For the disinfection of the skin, after the hair has been closely clipped off the operation area, the tincture of iodine is brushed over a wide surface and allowed to dry in before making the incision. It has also in many directions displaced the rather laborious preparations in the sterilization of the operator's hands, the tincture being painted or well rubbed in all over the hands so as to penetrate into every crevice in the epidermis, and under the skin covering the matrix and under the free edge of the nails, and then allowed to dry into the epidermis. Although this may be found to be a safe method when adopted by surgeons, who usually pay great attention to their hands and keep them clean, it would be safer still if the usual precautions of cleanliness by scrubbing with soap and hot water and paring of the nails were carried out as a preliminary. After completing the suturing of a cutaneous wound, good results are obtained by painting a coat of tincture of iodine along the course of the wound and sutures, and, provided the deeper tissues are free from infection, union by first intention is obtained. If a coating is painted on the wound daily stitch suppuration is prevented. But this daily painting is not necessary if the wound as soon as it has been sutured is covered with a fortified layer of collodion. On delicate skin such as that covering the scrotum the application of tincture of iodine should not be repeated, except after an interval of several days, or a painful dermatitis is likely to be set up. It acts equally well on the horse, ox, sheep, and pig as on the cat, dog, rabbit, and bird. In consequence of its coagulating proteins irritating the tissues, and low penetrating power, it gives less satisfactory results when used with the object of sterilizing deep wounds, which still continue suppurating during its use.

The application of tincture of iodine to the navel immediately after birth is largely adopted to prevent navel-ill and other infections gaining entrance through the umbilicus. It is frequently injected into sinuous wounds in soft tissues, into bursal cysts, hæmatomata after the evacuation of the clotted blood, hydrocele, and similar conditions. The ammoniated tincture or so-called colourless tincture of iodine injected into the sac of bog-spavin in order to set up irritation and ultimately absorption has, in the hands of Deans, given good results.

Iodine in the form of glycerine of iodine is an excellent antiseptic for chronic auricular catarrh with thickening of the investing membrane of the external ear in dogs and cats; it is the best agent for parasitic canker, and as an anodyne for auricular irritation in all species from the horse, ox, sheep, goat, pig, down to the dog, cat, ferret, and rabbit. In the form of an ointment with vaseline, either with or without the addition of oleic acid or any other organic acid, or as a liniment with oleic acid or liquid paraffin, it makes an excellent stainless absorbent application for the reduction of chronic inflammatory swellings and glandular enlargements, and to promote absorption from serous cavities. Mixed with vegetable tar and sifted tan or peat it forms a useful topical treatment for "capped elbow" and "capped hock." Mixed with 3 to 10 parts of pure carbolic acid to 1 of the iodine and injected into sinuous wounds, especially those on the coronary region and those found in botriomycotic and actinomycotic lesions, it acts as a painless escharotic, destroys the secreting surface, and sets up healthy granulative, and hence reparative, action. Iodine dissolved in carbon tetrachloride has been used for sterilization of the hands and skin.

Iodoform is inferior to iodine as an antiseptic, and it has very little germicidal action *in vitro*. It does not destroy pathogenic bacteria, but it inhibits the growth of putrefactive organisms. It acts by its effect in reducing secretion from wounded surfaces by hindering emigration of leucocytes from the blood-vessels, and by the fact that iodine is liberated by contact of iodoform with the organic material of the tissues and secretions. It enters at once into combination with the proteins, acting as a stimulant and facilitating absorption of the exudate. It is chiefly used as a dusting-powder, which not only acts as an antiseptic but also as a sedative and anæsthetic to wounds. Dissolved in ether and brushed on the surface of wounds it leaves a very fine granular layer of the drug; in collodion, as a protective dressing for small incised wounds. In both cases it should be freshly prepared, as the iodoform undergoes decomposition if kept for a time in such solutions and forms an irritating compound. It may also be used as an ointment for painful wounds and ulcers, and as an oil or emulsion for fistulæ and sinuses. Forced into a narrow cylindrical glass tube the powder may be pressed from this by means of a probe into fistulæ and sinuses. As an insufflation it may be forced into the nasal channels in chronic nasal catarrh. As a dusting-powder it is inferior to a mixture of iodine and starch.

Silver nitrate has a bactericidal action superior to that of mercuric chloride. It is a powerful antiseptic, and in 1 in 1000 to 1 in 500 of distilled water is invaluable for the washing of the conjunctival sac or urethral canal and also the canal of the sheath of the penis, and the nasal channels and the nasal duct. In a pure state, formed into the shape of a hard or toughened pencil, it is the best-known potential caustic or cautery and an excellent hæmostatic for small hæmorrhages on surface wounds.

Sodium chloride has long been known as possessing antiseptic properties, and when 7 parts are boiled in 1000 of water it forms a safe irrigant for operation wounds and for washing away extravasated blood from contused wounds. After the application of nitrate of silver it may be used for irrigating the conjunctival sac, to wash away the precipitate and to counteract its over-effects; the uterus, after extraction of the fœtus; the vagina and nasal channels, to remove tenacious mucus and bacteria; and in septic wounds, to wash away the discharges.

In the form of normal saline solution (7 parts in 1000 of boiled water) it is invaluable when injected into a vein, the peritoneal cavity or the rectum, or infused under the skin by hydrostatic pressure to make up for the loss of fluid from the circulation resulting from profuse hæmorrhage following parturition, operation, or accident. It forms a safe irrigant for the thoracic and peritoneal cavities. In shock, it is indicated to overcome the fall of blood pressure. It is contra-indicated in wounds where there is much oozing of blood from small vessels, as it prevents the formation of fibrin and hence delays coagulation. It may be permitted to remain in contact with living tissue without any injurious effect. It is more suitable for the mechanical cleansing of clean wounds than it is for infected wounds, as probably when kept in too long contact with the infected material it may set up general infection or intoxication. It should not be allowed to remain in an infected cavity. Saline solution is isotonic with the tears and blood. Holding one's hands in a warm solution enables one to taste the salt on one's tongue within a few moments, thus showing how rapidly it is absorbed by the normal skin.

This physiological salt solution, also termed normal saline solution or isotonic salt solution, contains 0·91 per cent of sodium chloride. It is isotonic since it has about the same equivalent as blood-serum and the lachrymal fluid. When higher molecular concentrations are used they are spoken of as hypertonic and lower as hypotonic.

Ringer's solution, which is composed of sodium chloride 0·91, potassium chloride 0·025, calcium chloride 0·02, sodium bicarbonate 0·015, with sufficient water to produce 100, is sometimes preferred to the normal saline solution.

Soap is an antiseptic and detergent as well as a solvent of fatty and horny material. It is used for cleansing the hands of the operator as well as the skin covering the operation area. In a 2·5 to 5 per cent solution of either hard yellow soap or soft soap it has a bactericidal action and is used for irrigating the natural channels prior to operative interference; it has a beneficial action in septic wounds by washing away the discharges, stimulating the separation of necrosed parts and rendering the surface sterile.

Cocoa-nut oil soap is said to have the highest bactericidal action. Those made from castor and olive oils have only bactericidal properties when used in a 5 per cent solution. It increases the bactericidal action of creosol, formalin, and coal-tar.

The green soft soap may be converted into a liquid soap by the addition of one or more times its weight of methylated spirit or half to one of ether. Such soaps may have added to them to increase their antiseptic properties oil of turpentine or eucalyptus, creolin, creosote, izal, or oil of lavender. Some ethereal soaps have as much as 1 per cent of mercuric iodide added to them and hard soaps as much as 3 per cent. Methylated ether added to spirit soaps lessens their viscidity. A liquid soap without spirit may be prepared by boiling olein with soda-lye. A turpentine soap is made of one part each of oil of turpentine to two parts of soft soap. The soap and glycerine are heated together and when cool the turpentine is added. Pumice and marble soaps are prepared for cleansing the hands and removing coarse epidermis.

Tincture of saponine or quillaia is a powerful antiseptic for wounds. It was used as far back as 1850 by Le Bœuf for the saponification of coal-tar (1 part tar to 2-4 tincture of saponine). Lemaire, in 1860, used 1 part of this mixture to 4 of water for the disinfection of wounds. The same authority in 1863 introduced carbolic acid for the same object. It is interesting to note that Lemaire was the first to realize the truth of Pasteur's work in its application to wounds.

Copper sulphate in 1 in 1000 is an astringent antiseptic suitable for the irrigation of infected mucous membranes and certain accidental wounds. It has been used for irrigating the genital passages after epizoötic abortion, specific urethritis, and the nasal channels affected with chronic catarrh. Used in a 5 to 10 per cent solution it is useful in grease and exuberating granular surfaces, as it constricts the blood-vessels and lessens the blood supply to the part. In the form of a very fine powder it is dusted on for the repression of that exuberant granulation tissue so often found following lacerated wounds of the skin covering the metacarpal and metatarsal regions. After it has been applied the part must be firmly bandaged. In the form of a pencil it is used to touch up granular lids, or as a crystal to verrucose granulations found in the vagina or on the penis of dogs affected with infective granuloma.

Sodium hypochlorite, prepared by the action of sodium carbonate on a solution of chloride of lime, was first introduced by Berthollet as a disinfectant and deodorant. The B.P. solution is composed of chloride of lime 10, sodium carbonate 15, water 100. Labarraque's Solution is about one-fourth the strength of this.

Labarraque's Solution and **Eau de Javelle,** which is a solution of chlorinated potash containing 2·5 per cent of chlorine, have long been used as disinfectants and antiseptics for infected and gangrenous wounds. In 1840 Renault, of Alfort, published a memoir on the treatment of wounds, and recommended chlorinated soda as a valuable disinfectant for gangrenous and other wounds. Both Blaine and Youatt spoke highly of its virtues as an antiseptic and deodorant for fœtid ulcers in the mouth, gangrenous wounds, and phagedenic ulcers. As time went on and fresh men came along with new ideas and remedies this valuable agent became no longer the correct thing to use, and so it was discarded and practically lost sight of until Dakin quite recently reintroduced it in a less caustic or irritating form.

Although the chlorinated solutions mentioned above are valuable germicides, disinfectants, and deodorants, they are very irritating and often cause grave injury to the tissues. This is due to the fact that they always contain free alkali, which may also be increased when brought into contact with the proteins in the discharges and tissues. They have also a hydrolytic or dissolving action on the tissues.

In order to overcome these objections to its use in the sterilization of infected wounds, Dakin introduced boric acid in the chlorinated soda solution and thus rendered it almost neutral under all conditions and deprived of its irritating properties. Dakin's Solution contains a mixture of hypochlorite and polyborate of soda and small quantities of free hypochlorous acid and boric acid. Should any alkali be formed it would be immediately neutralized by the boric acid and the acid borates found in the solution.

Dakin's original solution was composed of: anhydrous carbonate of soda, 140 grammes (or crystallized soda carbonate, 400 grammes), chloride cf lime of good quality, 200 grammes, ordinary water 10 litres, boric acid 40 grammes. The carbonate of soda is dissolved in the water, to which is then added the chloride of lime. After being well shaken and allowed to stand for half an hour to become clear, the liquid is syphoned off and filtered through cotton. To the filtrate the boric acid is added, so that the solution may be used at once.

As there were several drawbacks to this solution, Daufresne endeavoured to remove them by preparing it in the following manner: chloride of lime (having 25 per cent active chlorine) 200 grammes, carbonate of soda anhydrous 92 grammes (or crystallized carbonate of soda 262 grammes), bicarbonate of soda 76 grammes.

Into a 12-litre carboy 200 grammes of chloride of lime and 5 litres of tap water are placed and shaken vigorously two or three times and left for twenty-four hours. The carbonate and bicarbonate of soda are dissolved in 5 litres of cold water. This is poured in the chloride of lime solution and shaken for a minute and then set aside for the carbonate of lime to settle. At the end of half an hour the clear liquid is syphoned off and filtered through double paper in order to obtain a perfectly clear product, which should be kept in a cool and dark place, preferably in a black carboy. The solution, which should contain 0·475 per cent of hypochlorite of soda, with small quantities of neutral salts of soda, is then ready for surgical use.

It is isotonic with the blood serum. There is no danger when it is accurately prepared and used in fresh solution. No water must be added, as its bactericidal potency would become reduced.

The co-workers of Carrel have shown that below 0·45 per cent of hypochlorite of soda content the solution is insufficiently active, whilst above 0·50 per cent it is too irritating.

In order to obtain specific results with Dakin's Solution, Carrel has laid it down that it must be used under special conditions. For the chemical sterilization of infected wounds, as those of warfare, the solution is brought into all the recesses of the wounded surfaces by continuous or intermittent instillation by means of small rubber tubes. The tubes inserted into the wounds are perforated and fed by long conducting or instillation tubes supplied from a pear-shaped ampoule or flask suspended at a certain height from the patient. The outflowing tube attached to the nozzle at the bottom of the flask or container may be provided or not with a drop-counting contrivance and a stop-cock, so as to allow a continuous or an intermittent instillation.

The tubes are disposed in the wound in such manner that the liquid may readily spread direct over the whole surface. No gauze or other dressing must intervene between them and the wound. The tubes are arranged according to the shape of the wound, and as soon as they are in position gauze compresses soaked in Dakin's Solution as modified by Daufresne are applied so as to help to fix the tubes on the surface of the wound. The perforated part of the tube must be buried wholly in the wound in order to prevent the liquid escaping and possibly doing harm. The surrounding skin is protected by squares of gauze sterilized in vaseline. The dressing is completed by a sheet of cotton-wool protected on either side by one thickness of gauze.

Continuous instillation gives better results than intermittent instillation. But it is only suited to wounds where the liquid can remain in quantity. Intermittent instillation is used for extensive and irregular wounds having several openings. It is carried out by releasing for a few seconds every two hours the pinchcock which is placed on the irrigating tube just below the reservoir. The wound should be kept constantly moist. The instillation continues until all microbes have disappeared from the "smears." So long as a focus of infection, however so small, remains on the surface of the wound, total reinfection is possible. If the instillations be stopped or their frequency lessened, when the microbial curve shows only one or two microbes per field of the microscope, rapid reinfection may be brought about. By suppressing the microbes the hypochlorite solution does not lessen repair but accelerates it. In general, from three to four days are needed to sterilize a wound in the soft parts, and fifteen days or more for a compound fracture. These figures are those observed when the wound is sterilized before the suppurative stage. But if the treatment is commenced after the wound has already suppurated the duration of the instillation period is usually much longer. Bacteriological examination alone can indicate the time when the instillation may be discontinued. As soon as the wound no longer contains any microbes it may be closed.

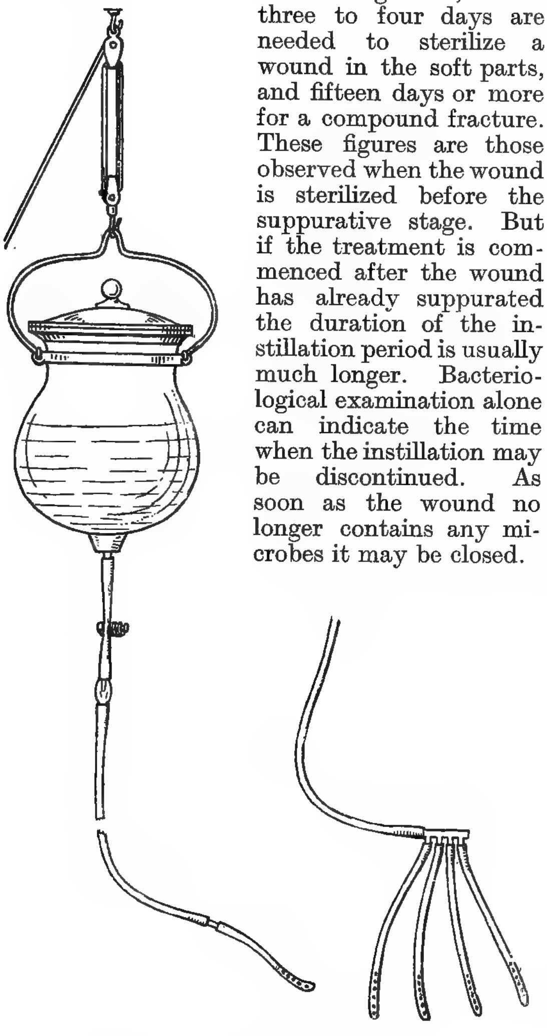


Fig. 219.—Instillation apparatus.

Dakin's Solution is harmless when injected subcutaneously but dangerous intravenously, as it is hæmolytic. It should never be injected under pressure into deep wounds for fear of absorption. It is only slightly toxic and does not set up any marked irritation in wounds. On tissues deprived of circulation it brings about their dissolution, and the surface of the living tissues rapidly clears up. Clots and gangrenous material dissolve. It destroys toxins in pus and microbes.

It therefore acts on the microbes, free anatomical elements, and necrosed tissue. It does not injure tissues provided with circulation. It has a profound effect on the process of repair.

Such are the salient facts concerning Dakin's Solution and its application in practice by Carrel and his co-workers. For a fuller and more detailed account the reader is referred to Child's translation of the little work on *The Treatment of Infected Wounds*, by A. Carrel and G. Dehelly, 1917.

Eau de Javelle, when used as a 15 per 1000 solution, acts similarly to Dakin's Solution.

Chloramine T., or para-toluene sodium-sulphochloramide, is manufactured from para-toluene-sulphochlorate, a by-product in the manufacture of saccharine, and has been introduced by Dakin for practical use in the sterilization of wounds. It has a high germicidal power. It is very soluble in water and is stable. It does not coagulate proteid matters in the ordinary treatment of wounds. It is used 1 in 500 to 1 in 1000 solution and acts in a manner similar to that of Dakin's Solution.

Antiformin is a trade name given to a solution of chlorinated soda which is said to contain 5 per cent of available chlorine and 7·5 per cent of sodium hydroxide. A 1 in 20 solution will destroy most germs in five minutes, but not the acid-fast bacilli such as those of tuberculosis and Johne's disease.

Eusol is composed of equal parts of chloride of lime and boracic acid. To this combination in a dry state has been given the name **Eupad.** Of this 25 grammes are added to 1 litre of water and filtered. This solution is said to contain 0·5 per cent of hypochlorous acid or 0·27 grammes of hypochlorous acid in 100 c.c. of the solution. It is used for infected wounds. It has an irritating action on the living tissues. The same objections to Labarraque's Solution and Eau de Javelle apply equally to this preparation. It is, however, very efficacious in recently highly-infected wounds which cannot be properly treated by the Carrel method.

Fresh chloride of lime 1 part, with 9 parts of dry powdered boracic acid, is recommended by Vincent as a highly-powerful antiseptic or germicide dry dressing for infected wounds.

Flavine (acriflavine), proflavine, brilliant green and other aniline dyes, either 1 in 500 to 1000 aqueous, spirituous, or normal saline solution, have been recommended as powerful bactericides and promoters of epithelial regeneration in infected wounds, but, according to certain reliable observers, they are inferior to some of the well-recognized antiseptics and germicides.

Acetozone is a powerful bactericide, but its price precludes its use in general veterinary practice. It is non-toxic, does not irritate, and promotes reparation. The solution is made by adding 5 to 7 grains to 1 pint of sterile water at 122° F. and left to stand for two hours. It should not be filtered.

Drainage

One of the principles instituted for the successful treatment of aseptic and infected wounds is the removal of secretions. This is to a great extent not required in operation wounds where strong and irritating solutions of antiseptics are avoided, hæmorrhage is arrested, all blood-clots removed, " dead spaces " or pockets for the collection of serum and blood obliterated, strict asepsis carried out, and firm pressure maintained.

Drainage is obtained by making a fairly wide dependent orifice or by inserting a drain into the depth of the wound with an outside or low-level outlet. It is indicated in accidental wounds, in the open method of castration, in those operation wounds forming large and deep cavities, as in cystic elbow and knee, shoulder abscess, poll-evil, fistulous withers, in those suppurations with burrowing into intermuscular spaces, especially those in the anterior femoral region, in large hæmatomata, purulent collections, and in pleural, pericardial, and peritoneal effusions.

A drain should always be used where blood-clots exist and are not removed, serum is secreted, and infection present. Serum, blood-clots, and purulent collections, if pent up in a wound, form good culture media for putrefactive bacteria, and if absorbed into the system they set up malaise when they do not produce general infection or serious intoxication.

A dependent orifice can be obtained by making a wide incision or opening into the lowest part of the outer wall of a pocket of tissue in deep horizontal or vertical wounds or in circumscribed suppurations. In the case of a vertical or oblique wound in which there may not be any pocketing or hollow spaces, leaving out one or two of the sutures at the lower end of the wound suffices to afford drainage.

In those instances in which mechanical means may be deemed advisable in the drainage of wounds, abscesses, cysts, and sinuous cavities, it is not necessary to make a large opening but only one sufficient for the passage of the drain. The opening or perforation may be made with a pointed bistoury, sharp-pointed seton needle, or trocar and cannula.

Many materials have been introduced for mechanical drainage purposes, such as tow, lint, gauze, ribbon or tape (impregnated with antiseptics or germicides), silk, catgut, silkworm-gut, horse-hair, kangaroo tendon, and perforated glass, vulcanite, rubber or metal tubing. They are usually maintained in position by their own pressure in the wound, by a bandage or other dressing, or by a suture, drainage-tube pin, or safety-pin passed through the material and the lip of the wound.

The commonest drainage material used in veterinary practice is coarse linen or fibre tape passed in the manner of a seton and knotted in the form of a bow at both ends to prevent it slipping out of position. Instead of a bow-knot, each end may be passed through a perforated disc of leather and then knotted. Sometimes both ends are tied together so as to form a loop and not get displaced by the movements of the animal.

Packing a cavity with a strip of gauze or a pledget of tow is another very common method adopted in veterinary practice. It is very useful where drainage cannot be effected by a dependent orifice. The use of tow is objectionable because after the pledget is removed fibres of the material are liable to remain, acting like a foreign body in the wound, and unless removed prevent reunion.

A very useful drain is made of a strip of gauze rolled into the shape of a cigarette, the middle part of the roll being encased in thin rubber tissue, leaving both extremities for an inch or more uncovered by the rubber (*cigarette drain*). Other modifications of this drain are made of strands of silk, short narrow strips of gauze, or short lengths of cotton-wick. Such drains, before being introduced into wounds, should be moistened with an antiseptic solution in order to facilitate capillarity.

In case of an operation wound showing signs of infection, as redness or a purplish tint and puffiness, which is most marked at the site of the sutures, rather than remove the whole of the sutures and allow the wound to gape it is better to remove the sutures at either end of the wound and establish drainage by drawing through the wound under the remaining sutures a strip of iodoformized gauze threaded on a probe or seized by thin sinus forceps passed through the wound.

Drains may also be made of several strands of horse-hair, silkworm-gut, catgut, or silk doubled so as to form a loop at one end. The free ends may be kept together by plaiting or by interweaving a fine piece of silk commencing from the neck of the loop and working downward to the free ends. The loop end is placed in the depth or the distal end of the wound and the free ends hang out of it.

Capillary drainage is effected by a few long horse-hairs passed vertically through the whole depth of a cyst or abscess by means of a long needle or eyed-probe, each end of the drain being knotted to keep it in position.

Rubber tubing of various calibres is prepared for the drainage of deep wounds, sinuous wounds, and large cavities. It is either perforated or has a continuous spiral cleft running from one extremity to the other (Fig. 220, *a* and *b*). It is introduced by means of a *probe-like instrument* provided with a small fork at one extremity and perhaps a handle at the other ; or by means of a fine pair of long forceps. It is generally difficult to maintain in most wounds in animals, either becoming detached by the movements of the animal or, as in the case of dogs, by being removed by the teeth. It is usually fixed in position by means of a safety-pin or a metallic suture passed through one side of it and one of the lips of the wound.

Spiral wire tubing is a useful form of drainage-tube (Fig. 220, *c*). *Leaden* composition tubing, as used by plumbers and electricians, makes, when it has received many perforations, an excellent drain, as it is relatively light in weight, does not irritate, can be easily sterilized by boiling, and can be bent to any shape or angle.

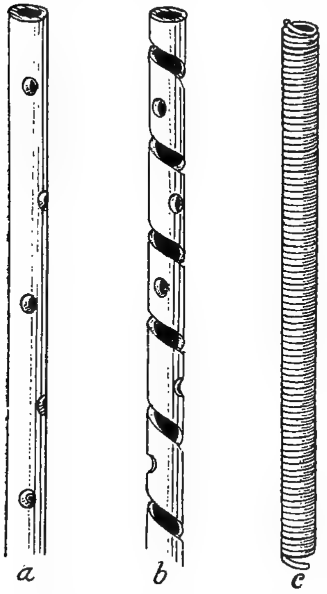


Fig. 220.—Drainage tubes.

Special drainage-tubes composed of rubber, vulcanite, metal, or glass are made with flanges or collars for the drainage of the chest and abdominal cavity. In consequence of their fragility and the damage they are likely to undergo by the movements or the actions of the animal, glass and vulcanite are generally unsuitable in veterinary surgery. The tube is passed into the cavity to be drained and is either fixed by suture to the wound or kept in position by virtue of the flange.

All drainage-tubes, before use, should undergo sterilization by boiling or disinfection by immersion in a 10 per cent solution of lysol ; they should be removed from time to time and sterilized or disinfected afresh. The metal ones should be boiled for twenty minutes in water containing a small quantity of hard or soft soap, which acts much better than carbonate of soda. As the wound fills up the drain should be shortened. It may be removed altogether from those wounds which are unpocketed, free of necrotic tissue and foreign bodies, have ceased suppurating or discharging, and are on the fair way of healing by granulation.

Care should be taken that the tube does not become blocked by blood or tissue, by bending or compression, or by granulations occluding the openings.

Setons used as drains should not be left in too long, as they may cause thickening of the skin or cicatricial fibrosis around the points of entry and exit.

Drainage of the facial sinuses merely requires an outlet made at the lower or dependent part on the outer face of the bone. In the case of sinuous wounds in the region of the hoof setons may be passed after the horn has been thinned, or an opening made by passing a red-hot, thin-pointed, and slightly curved firing-iron through the upper orifice and bringing the point through the outer surface of the wall or even the sole. Infected wound or suppuration of the sensitive sole of the foot may be drained by simply removing the overlying horn.

Drainage of the uterus or the bladder can only be effected by catheterization, irrigation, and syphonage. It should be repeated within rather short intervals in order to prevent accumulation and absorption of the fluid.

The Treatment of Operation Wounds

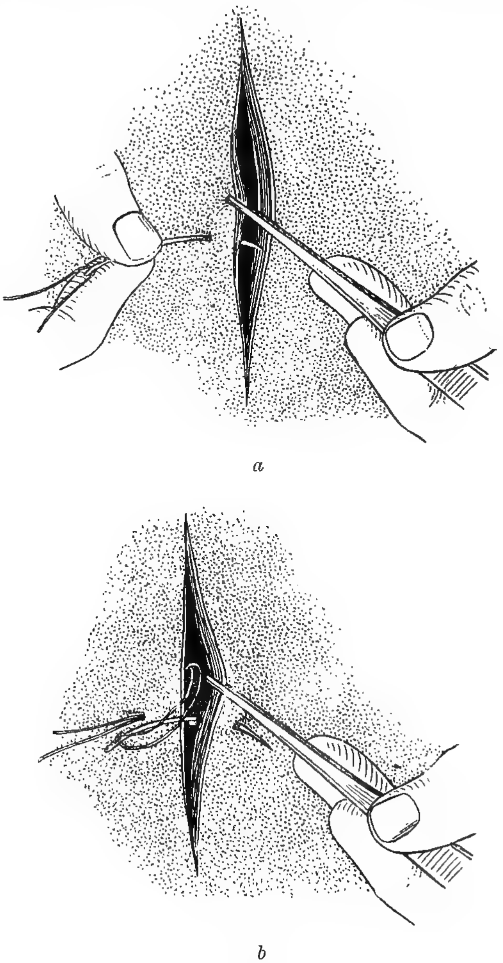
When an operation is completed the wound should be freed of shreds of tissue, which, if attached, should be snipped off with a pair of sharp scissors, and of blood-clots by gently wiping them away with a sterilized sponge or gauze pad, which may either be used in a dry state or after being immersed in an antiseptic solution and then squeezed out. If there should be any oozing of blood, firm pressure with the sponge or pad may check it, but if it still continues the wound can be washed out with a *hot* (150° F.) sterilized solution and pressure again resorted to. If the oozing persists after these measures, the sponge soaked in a hot saline solution should be firmly pushed into the wound and allowed to remain there until the sutures have been passed through the skin and deeper tissues. Before tightening the sutures the sponge should be removed, and if there should be any more oozing before the sutures are tightened the bleeding spot should be scored with a sharp knife a few times, or a fine silk suture passed around the surrounding tissues and tightened sufficiently to arrest the hæmorrhage. If this should not give the desired result a fine-pointed, red-hot iron or thermocautery should be applied, or the wound should be plugged with dry antiseptic gauze, which should be left protruding at one end and allowed to remain in position until the hæmorrhage has stopped, when it may be removed and the wound closed.

But the tightening of the sutures passed through the skin and the tissues forming the floor of the wound generally induces sufficient pressure to arrest or prevent any small hæmorrhage without the assistance of plugs, cauterizations, and hot solutions.

Care should be taken in closing wounds that divided tissues of like nature should be brought together, as the end of a tendon to the other end of the same tendon, muscle to muscle, fascia to fascia, and nerve to nerve, especially those in the limbs. Moreover, it is important for a quick recovery that the tissues should be so closely approximated that *no cavity* or *space* is left for blood, serum, or pus to occupy, as such "dead-spaces" remaining from imperfect contact of the surfaces of the deep tissues often prolong the repairing process of a wound, by setting up suppuration or forming deep sinuses, which should not be confounded with those set up by a deep infected suture. Both these "dead-spaces" and deep infected suture suppurations account for the surface tissues, which have healed up rapidly, breaking open and giving issue to pus. In the deep or buried infected suture suppuration the pus, generally small in amount, issues from a small circular hole in the skin. In many instances it does not appear until the lapse of several weeks after the closure of the wound.

If these "dead-spaces" cannot be obliterated with sutures in conjunction with external pressure in the form of a compressing bandage, it is necessary to invoke the aid of drainage, which is seldom required in other circumstances where strict asepsis or antisepsis is observed and no irritating antiseptic solutions are used.

In the approximation of wounds made by the surgeon the size of the needle and the suture material, as silk or silkworm-gut, should not be any larger than is necessary to pass the suture and to maintain the lips of the divided tissues together in a perfect state of apposition without snapping from tension. For small wounds such as those caused by incision of the skin, as in plantar neurectomy and in abdominal operations on the smaller animals, Japanese silk of the size 00 to 1 is sufficient for the purpose, whereas in very large and deep abdominal wounds in the horse where there is much tension Chinese silk twist of No. 6 size may be necessary. It should be remembered that the larger the needle and the suture material the greater the damage to the tissues through which they pass, and in consequence the greater the chances of infection of the suture track. The needle to be used for passing through tough or resistant fibrous tissue, or the thick, leathery skin like that covering the haunch of the horse, should have a very sharp cutting point so that it can be pushed through the tissues with as little force as possible, and its short axis should be no larger than is necessary to carry the suture material with ease. As every stitch proportionately damages the tissues and increases the chance of wound infection where strict asepsis or antisepsis cannot be assured, no more stitches than are necessary should be used.


a

b

Fig. 221.

In order to suture a wound, especially a small one, with ease and without putting the lip or flap too much on the stretch where the needle is about to penetrate the skin, a fairly large pair of thumbspring forceps with mouse or rat-toothed points should be used to hold and gently raise the flap so that it is not pushed away when the needle is being passed. This method is shown in Fig. 221 ; it is of great assistance to the operator, and less liable to contaminate the skin-wound than when the fingers are used. In fact, there is no necessity to touch the wound with the fingers if these forceps and a needle-holder to pass the needle are used. These instruments can be more thoroughly sterilized than the fingers, and in the intervals during the passage of the sutures they can be placed in a cylindrical vessel containing a 5 per cent solution of carbolic acid or of lysol. Under these circumstances the closure of a wound may be performed quite aseptically. In operations on the abdominal wall under an anæsthetic a handled needle such as that of Reverdin may be used instead of a needle passed with a pair of needle forceps. Such handled needles are, however, very fragile, and are liable to snap when being passed if the animal should struggle. A great number of operation wounds become infected by being fingered too much at the time of closure.

In tightening the stitches before tying the knot, which should be preferably the surgeon's knot, as it is less liable to slip than other knots, traction should not go beyond the degree necessary for the lips of the wound to be brought into a perfect state of apposition, else the lips will pucker up and the degree of tension will thereby be so increased as to strangle the tissues, or to cause the stitches to cut through, unnecessarily damaging the tissues and preventing union by first intention. In certain instances these effects nullify the success of the operation, and in intra-abdominal and hernial operations endanger the life of the animal.

Care should be taken that the lips are brought into a perfect state of apposition the whole length of the wound, else there will be a puckering or rising of the lip, here and there, on one side or the other of the incision. Where there is ragged edge or a superabundance of tissue on one side, this should be removed or reduced to proper proportions with a strong pair of sharp scissors in order to make it equal in length with the opposite side. In case this redundancy of skin covers a large surface, as shown in Fig. 222, the reduction may be made by excising a more or less long narrow, V-shaped piece of skin at right angles to the wound, as indicated by the dotted lines in the same figure. The resulting wound, together with the original wound, is then brought together with interrupted sutures (Fig. 223). Great discrimination is, however, required in carrying out the excision of normal skin, as in case the wound should be infected it is liable to undergo suppuration with bursting of the flaps of the wound, so that repair can then only be obtained by the granulation of a large, gaping surface which generally in the end becomes covered to a great extent with scar-tissue, leaving a permanent blemish which greatly depreciates the value of the animal from an æsthetic point of view. Where the wound is likely to become infected it is better not to remove any redundant skin, as in the process of granulation the skin generally goes back into its normal position without leaving any slackness, and, beyond a narrow linear scar, very little blemish. While on this subject of indelible scars it is well to point out that big sutures without strict asepsis or antisepsis generally lead to wide, suppurating stitch-tracks which result in big-stitch scars.

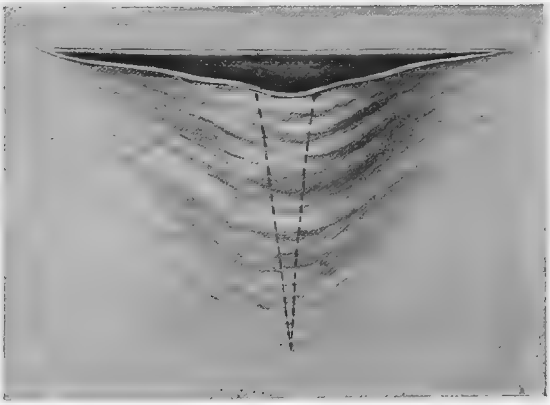


FIG. 222.

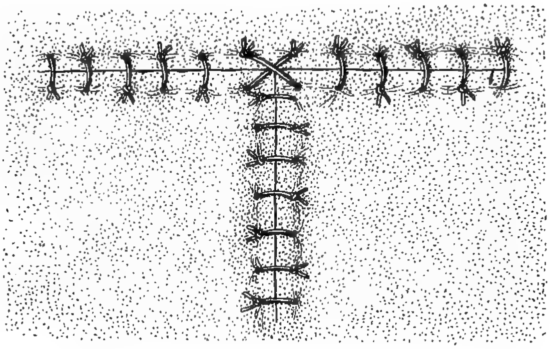
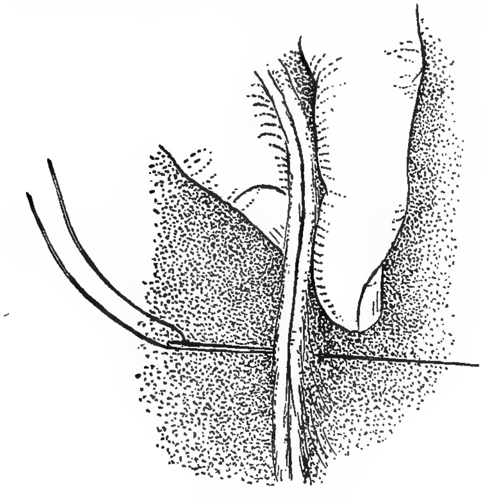


FIG. 223.

To obtain even approximation the wound should be put on the stretch by means of forceps, catching up the skin at each end and drawing them apart. Or, in the case of a wound of moderate length, the lips may be kept in exact apposition by holding them together between the thumb and index-finger (Fig. 224, *a*), or by the use of Moynihan's double-pronged dissecting or fixation forceps (Fig. 224, *b*) during the time the sutures are being passed.

In concluding this section it is well to direct attention to the protection of wounds made through the abdominal wall as a preliminary to operation on visceral organs as the stomach, rumen, intestine, and bladder, in order to prevent their raw surfaces becoming soiled with infective material either from the outside of the body or from within the visceral organs (intestinal contents, infected urine).

This protection is usually afforded by covering the region and also the lips of the abdominal wound with an aseptic or antiseptic fabric as linen, cotton, mackintosh, or jaconet provided with a window, the outline of which is affixed to the surfaces of the wound by means of sutures or special forceps, which may, when occasion necessitates, be used as retractors (Fig. 225).



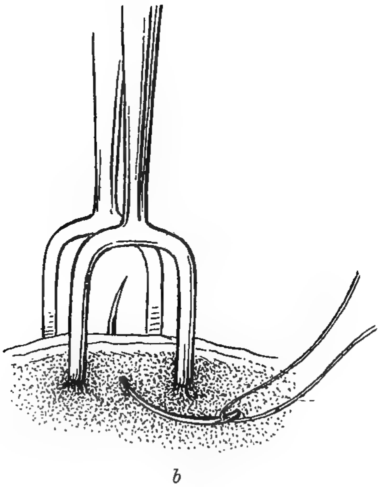


FIG. 224.

When the closure of the wound has been completed, its surface should be freed from all debris and then dried with a dry aseptic pad before being painted with tincture of iodine, and afterwards protected with an occlusive or supporting dressing.

Occlusive or Protective Dressing.—One of the principles for the successful treatment of operation wounds by the aseptic or antiseptic method is to occlude the outer surface of the wound, after it has been properly approximated, by a suitable dressing to prevent outside infection, and, if necessary, to support it by an effective bandage so as to keep it in a perfect state of rest as well as to maintain the different layers of tissues in close approximation in order to prevent any recurrent hæmorrhage, and to eliminate any possible "dead-space" for the accumulation of blood, serum, or pus; also to prevent any escape of visceral organs should undue tension be put upon the sutures before the wound has had time to repair.

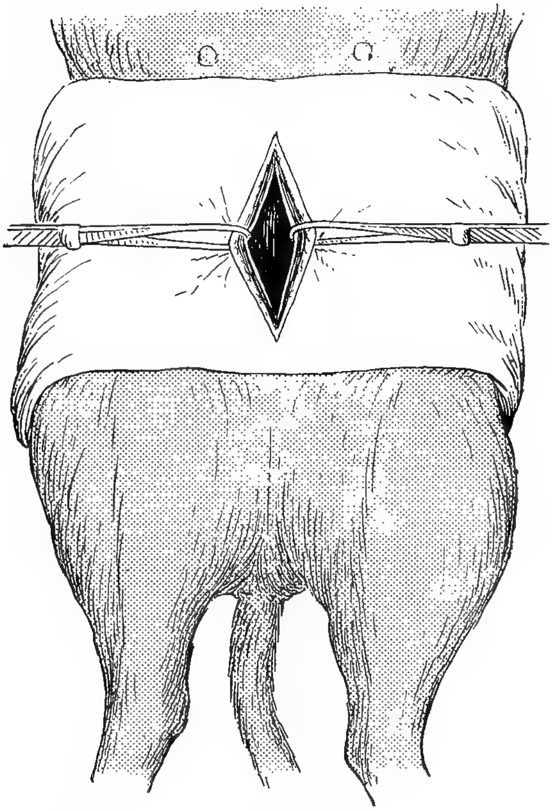


FIG. 225.

In small superficial wounds and those made in the abdominal walls in the course of operations on viscera of the smaller animals the outer surface may be protected with collodion applied with a brush, and fortified or reinforced with a layer of finely-teased-out cotton-wool extending over the whole wound and beyond it for an inch or two before it is allowed to dry, and to form an impermeable covering. Such a dressing prevents any outside infection, and if the deeper surfaces of the wound have not become infected before closure, no "dead-spaces" allowed to exist, and no irritating antiseptic solutions have been used so as to produce an outpouring of serum, the wound should undergo reparation by first intention without discharge soiling the outer surface of the overlapping dressings, which may be applied to give the wound support. It is better to use over this collodion protective or occlusive dressing a firm pad of cotton-wool or peat-wool, maintained in position by the application of a bandage which should be kept on for four or five days. After removing it to examine the state of the wound it should be reapplied.

This collodion or similar protective dressing should not be used when it is anticipated that there will be oozing of blood or serum from the wound. Beyond the preliminary painting of the wound with tincture of iodine with the object of killing or inhibiting bacteria in its vicinity, there is no necessity to add iodoform or any other antiseptic or germicide agent to the collodion. Unless in the case of the addition of iodoform, the protective is freshly prepared each time with collodion made with pure ether. If the operation has been performed aseptically, simple methylated collodion will prevent infection from the outside. The animal should not be released nor the compressive dressing applied until the collodion has set by evaporation of its ether. The protective dressing is used only with the object of supporting the wound and not for the purpose of absorbing discharge. As the collodion sets it draws by its contraction the lips of the wound more closely together. Care should be taken that the lips of the wound do not in the least gape when the collodion is applied, else some of it may enter the space between the lips and even underrun them, thus acting as a foreign body and preventing approximation.

At the end of a week or thereabouts the bandage may be removed, and the layer of collodion allowed to separate from the skin on its own accord, when the superficial sutures may be removed.

Besides collodion, celloidin, which is pyroxylin purified by solution in alcohol and ether, is also used; and filmogen, an acetone solution of celloidin and photoxylin, a similar preparation, formalized gelatin, and a spirituous solution of shellac are also used as substitutes.

Many superficial operative wounds, and more especially those of the ears, eyelids, nostrils, or lips, after they have been sutured exude a little blood or serum which dries up into a varnish-like material and forms not only a bond between the two lips but also an impermeable barrier to external influences. The scab gradually contracts and draws the two lips closer together, and when it has fulfilled its function it falls away piecemeal and leaves a smooth surface. Such healing under a scab may be favoured by brushing the wound after it has been sutured and cleansed under antiseptic precautions with friar's balsam, which forms an impermeable antiseptic varnish; or by sprinkling on it a mixture of powdered sugar and iodoform or any other desiccating material, as powdered myrrh or a mixture of kaolin, boracic acid, and iodoform or tannic acid. Formerly the application of powders, such as iodoform, boracic acid, iodine and tannic acid, salicylic acid or bismuth, was much in vogue in the treatment of surgical wounds, even those with much serous excretion. The powder was covered with lint, gauze, cotton-wool, or peat, which was kept in place by a bandage. The discharges entered into combination with the chemicals, which inhibited the growth of the bacteria found on the surface of the skin in the vicinity of the wound. This practice for operation wounds, however, has not given the satisfaction that other methods have given, and now it is rarely employed unless in the case of abrasions and other superficial wounds. Nevertheless it is often adopted in infected wounds to limit putrefaction in necrotic tissues after the surface of the wound has been dressed with alcohol or other drying agents.

Protective and Supportive Dressings.—These are applied with the object of protecting the wound against the invasion of infective bacteria from the outside, of receiving any serous discharge that may issue from the depths of the wound, and to prevent its decomposition, and above all to give support to the whole wound in order to keep its component parts in contact with one another and thus obliterate any dead-spaces, and to obtain for it, as far as possible, a state of rest, which is one of the great essentials to the successful repair of a wound by first intention.

It is a much more difficult task to apply and maintain dressings over wounds in animals than in man, and in many regions it is almost impossible in consequence of the movements of the animal, which are likely to cause their displacement even when the animal does not remove them with his teeth, as often happens, unless precautions are taken to obviate this by some mechanical device. It should, however, be pointed out here that displacement or removal of the dressing by the animal should warn the attendant that the dressings are causing discomfort or pain, that the wound is infected, or the dressings are saturated with discharge and require readjusting. Aseptic wounds, which do not necessarily imply sterile wounds or those undergoing repair by first intention, rarely give rise to pain, discomfort, or itchiness, which attracts the attention of the animal to them.

In order to limit movement of such regions as the limbs, and also to retain dressings in such operations as suturing of disunited fractures or divided tendons, and for the removal of old scars from the knees, splints are necessary. Any undue strain of the parts due to the movements of the animal before repair is effected is very liable to render the success of such operations nugatory. *The parts must be kept in a continuous state of apposition and absolutely at rest* if successful results are to be obtained.

The best kind of splinting material for this purpose is wire-netting as used for aviaries for small birds. It can be procured in ⅜ or ½-inch mesh and having gauges varying from 22 to 20 and 19, the lowest number gauge being the stiffest. It can be moulded into any shape by cutting, bending, or hammering so as to fit the part for which it may be required. Windows or doors can be made into it so that the wound can be dressed through the opening. After it has been well padded and all unevenly fitted surfaces have been effaced on the limbs, it can be maintained by tapes or bandages. Woven wire, like that used in the manufacture of sieves, which can be obtained in various meshes and gauges and the component parts soldered, may also be used. No non-absorbent material such as unbleached cotton-wool should be used for padding, as such in constant contact with the skin of animals causes a desquamative dermatitis. This wire-netting forms the best and lightest material for splints or a rigid framework for the maintenance of a dressing for any condition for which it is applicable.

Dressings applied to wounds on the limbs of the smaller animals are best maintained by a narrow (1 inch) water-dressing bandage, the turns of which should be smeared with pitch-plaster (B.P.) so as to prevent slipping.

Where splints are used on dogs after suturing the non-united ends of a fractured femur or humerus, the foot should hang free for an inch or so below the lower end of the splint and be fixed so that it cannot be drawn above the end of the splint. This is necessary in order to keep the limb in a state of extension and to prevent undue tension on the suture. The splint should be applied when the limb is in an extreme state of tension, before the animal has recovered from the anæsthetic.

In those positions where a dressing or bandage is liable to become displaced by movements of the animal, leather-strapping, harness, tapes, or bandages may be applied around the trunk of the animal to prevent slipping.

Whatever dressing is used must be soft, pliable, elastic, and easily adaptable to irregular surfaces, and, above all, it must be readily absorbable and thoroughly sterilized and must not possess any irritating properties.

Many dressings, such as cotton-wool, peat-wool, tow, tenax, jute, gauze, and lint, which have been sterilized and had incorporated into them various reputed antiseptic agents, such as carbolic acid, lysol, cyllin, iodoform, iodine, eucalyptus, boracic acid, salicylic acid, double cyanide of mercuro-zinc, bichloride or biniodide of mercury, or zinc chloride, are put on the market in closed tins or cartons for this purpose, but too much reliance cannot be put on their being sterile or having much germicidal power, and at best many of them only possess deodorant properties, which in the case of those carrying volatile substances they lose after two or three days of their application to the wound. This can be accounted for by what one commonly observes in the manner they are handled, often with soiled hands, even when they have not been placed on dirty tables or corn-bins or on the ground not rarely fouled with dejecta or wound discharges. It is from this manner of misusage of antiseptic or aseptic dressings that wounds hitherto treated by a more or less strict aseptic technique become contaminated, bringing reproach on the antiseptic method in veterinary practice.

Those dressings impregnated with volatile substances, as iodoform, iodine, carbolic acid, or eucalyptus, lose their antiseptic or deodorant properties, especially if they become saturated with discharges, after a few days, and if not protected by some impermeable covering, such as mackintosh, jaconet, oiled silk, glazed or tarred paper, or tarpaulin, they soon become fœtid from decomposition of the albuminoid discharges. Under such circumstances they should be removed under antiseptic precautions and renewed with fresh dressings. The impermeable covering should be placed over several layers of the absorbent dressing and then covered in its turn with a layer or two of cotton-wool before applying a firm compressive bandage to include the whole.

In case of a discharge of serous fluid being anticipated, which is rarely the case where the wound is treated under strict aseptic and antiseptic principles without using irritating lotions or allowing "dead-spaces," provision should be made by the insertion of a drainage-tube or drainage material, or by leaving out a stitch or two at the lowest end of the wound, which should, when possible, be made in a direction favourable to natural drainage. Before applying any dressing it is better to disinfect by painting with petrol, tincture or ethereal solution of iodine the surface of the skin to be covered with the dressing. When the spirit has evaporated and the skin is dry, a layer or two of boracic lint should be placed over the wound and allowed to overlap it for two or more inches all round it. Over this lysolized or Burnettized[1] tow, carded peat-wool or cotton-wool for the depth of one to several inches, according to the size of the wound and the size of the animal, may be placed.

Above these layers the impermeable covering may be applied, and in its turn this is covered with cotton-wool and the whole kept in position by a firm and elastic bandage, preferably the tetra-bandage, but in lieu of this a woollen, cottonette, or water-dressing bandage. For wounds in the thoracic or abdominal region in large animals bath towelling, especially that termed "Hessian," forms a useful bandage, which may be prevented from slipping by fixing it to a surcingle and crupper or to a collar with tapes or other suitable material. In the smaller animals the bandage can be prevented from getting misplaced by pinning it with safety-pins to a coat or waistcoat made out of a piece of calico and provided with two or four holes through which the limbs pass. For broader bandages for the large animals thin sacking is a very suitable material.

It is better, where possible, as in the case of the smaller animals, and of the lower region of the limbs of the larger animals, to apply and fix the dressing during the time the animal is fully under an anæsthetic, in the recumbent position, or before removing the tourniquet, so that the pressure on the wound exerted by the dressing and the supporting bandage, which should be moderately firm but not so tight as to strangle the tissues and cause ischæmia, prevents any reactionary hæmorrhage, which is otherwise liable to, and often does, take place when the animal struggles to get up, or when on his feet, or after the tourniquet has been removed.

For operation wounds on the feet in larger animals, as that made in the excision of the lateral cartilage (Lafosse's operation), it is advisable to protect the dressing against becoming soiled with urine and fæces by enveloping the foot in tarpaulin or some other tough impermeable material, and then to enclose the whole in a leather or rubber boot.

All the dressings should be applied in a dry state, and not removed before the third day unless they become displaced, cause discomfort, or symptoms of septic fever supervene. In our patients it is advisable to remove them about this period in order to examine the state of the wound and to relax pressure of the bandage, which, as mentioned above, should in certain instances be applied with a high degree of firmness in order to prevent reactionary hæmorrhage.

If there should be, by any chance, a collection of blood under the skin, a stitch or two should be removed and the blood-clot carefully evacuated, and after the cavity has been washed out with a *sterilized* 1 in 4000 solution of biniodide of mercury a stitch or two should be put in, allowing a certain space between the stitches to exist for the issue of any serous fluid that may be formed. This subcutaneous hæmorrhage is known by the prominence of the skin, which has often a purplish appearance. Should there be any evidence of suppuration in a stitch-track the offending suture should be removed, as also those which are too tight from swelling and strangling of the tissues, which is known by their reddish or purplish discoloration. They may, however, be replaced by fresh ones. The relaxation, or deep-supporting, or pressure sutures should also be removed, as well as any other external sutures that have served their purpose. Before removing sutures it is advisable to wipe them and the wound surface gently with a piece of cotton-wool or lint squeezed out of a 5 per cent sterilized solution of zinc chloride, or to brush them over with tincture of iodine, so that on their withdrawal they should not draw into the track any infective material. The stitch should be cut with very sharp narrow-pointed scissors close to the surface the time the knot is held with a pair of thumb forceps, and then withdrawn in a manner so that the knot is not drawn through the suture track and the lips of the wound are not stretched.

The dressings should be removed and renewed in the same antiseptic manner in which they were first applied. They should be continued for four or five days longer, when the remaining sutures may be removed. Should there be any granular condition of the skin or edges of the wound the surface should be dusted with equal parts of boracic acid, zinc oxide, and kaolin, a combination which has a very reliable desiccating and cicatrizing effect. It is better to maintain the dressings and bandage until the wound has become firmly united, as until this has been effected any undue tension of those parts capable of great extension is likely to burst the wound and render fruitless all the previous care and attention that has been bestowed on the case. The success in obtaining the union of an operation wound by first intention depends greatly upon the care in which the first dressing is applied.

Besides the dressing materials mentioned above, rags, wool, and any other fabric having a high degree of absorbing power may be used after they have been plucked to pieces, sterilized by boiling, and then immersed in a 5 per cent solution of lysol, cofectant, cyllin, or Burnett's fluid, and afterwards dried. Dried sphagnum moss, soaked for some hours in 1 in 500 solution of perchloride of mercury and then squeezed out as dry as possible and put into muslin or gauze bags so as to form pads of an inch or more in thickness, forms a cheap and suitable dressing for many wounds. These pads may be made up in various sizes and shapes. Peat and also sawdust put up in similar bags may be used for the same purpose.

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[1] Dressing material treated with Burnett's (zinc chloride) fluid.

Where no iodine has been applied or remains on the skin, several layers of double cyanide gauze may be applied over the wound, and above these layers a mass of salicylic or alembroth wool is placed and then covered with some impermeable material and retained in position by a bandage. This forms an excellent dressing where exudation from the wound is anticipated.

On those wounds where no serous exudation is expected to occur, a piece of lint soaked in compound tincture of benzoin and squeezed out as dry as possible may be applied and covered with a thick layer of cotton-wool and maintained in position by a bandage. It acts in a manner as favourable as many other modern and more expensive dressings.

Besides the dry antiseptic method of treating wounds there is the older method of treatment with wet antiseptic dressings, which are more likely than dry dressings to cause irritation and maceration of the skin and wound. The best results are obtained when the dressings are boiled, squeezed out, and then immersed in a 5 per cent solution of carbolic acid, lysol, or such like antiseptic, and immediately applied to the wound and fixed by a bandage. This is kept on for several days and renewed as required. It may be covered with an impermeable material. It soon becomes dry, but has the disadvantage of forming lumpy or stiff layers. Probably it is the best dressing for use in country practice. Some authorities, to prevent the antiseptics irritating the lips of the wound, cover the surface with a narrow strip of oiled silk or jaconet before applying the dressing, first gauze, then cotton-wool, impermeable covering, cotton-wool, and finally a bandage.

The *simple water dressing* in which lint, tow, or some other absorbent material is saturated with plain water, as advocated by Liston and commonly adopted by veterinary surgeons, does more harm than good. The same may be said of irrigations with plain water.

The *wet treatment of wounds,* whether by moist antiseptic dressings or irrigations or by antiseptic baths, is only indicated in septic cases. To give good results, the dressings as well as the fluids should be sterile as well as antiseptic, without producing any irritation. They should be frequently renewed or continued until the wound has become sterile, when the dry treatment may be followed. Boiled water used at a temperature of 120° F. acts equally well. In fact, all liquids containing antiseptics act more beneficially when used at this temperature. This is particularly noticeable in septic wounds of the feet and phlegmonous conditions arising from infected penetrating wounds in the limbs, where continuous fomentations with hot water generally ward off dangerous complications. Heat applied in a continuous manner has a very high therapeutic value in the treatment of septic and painful wounds, as it has in many infectious processes.

The *open treatment* is that in which no dressings of any kind are applied. In general veterinary surgical practice this is the commonest mode of treating certain operative as well as accidental wounds. Provided it is carried out in an aseptic and antiseptic manner so far as instruments, hands, and surroundings are concerned, it gives very fair economical results. In castration and operations in which there is a wide dependent orifice for natural drainage and the tissues are not unduly injured by unskilful manipulation, no blood-clots are left in the wound to act as a nidus for the development of infective bacteria, and no soiled material comes in contact with the wound, the results are excellent. It gives better results in the country, especially in favourable weather, than it does in towns. It is more applicable to young and immature animals than it is to adults, whose tissues are more susceptible to adverse influences. No irritating lotions, liniments, or ointments should be used to lower the vitality of the tissues. Such a procedure should never be carried out in infected surroundings, as a lambing pen, nor in a filthy stock-yard, nor when the wind is in the east or north-east.

It is better to rely on boiled water used at a temperature of 120° F. than to trust to antiseptic lotions prepared with ordinary water at the time of using. Boiled water, boiled saline solution, and other liquids should be used in scrupulously clean utensils. A teaspoonful of a doubtful disinfectant in two gallons of well-water in a foul pail has neither aseptic nor antiseptic properties.

Bone Sutures.—Bone suturing is generally carried out in those cases of fracture where it is difficult or impossible to keep the fractured ends or fragments in apposition by means of splints and bandages, as in fractured patella in the horse and in fracture of the femur, humerus, and of the lower jaw in the dog. It may also be used for open, especially comminuted, fractures where there is great mobility.

For the purpose of this operation an all-metal Archimedean drill of 5¼ to 10¾ inches in length, stout silver wire, and a pair of wire-pliers with a cutting edge are necessary. Holes are bored through the bone a short distance from each end, the wire passed through and the ends brought together and twisted a few times; the superfluous wire is cut off and the remaining ends flattened down to the bone. Ivory pegs, steel nails, screws, spiked plates, steel bridges, oblong, angled, and Y-plates of nickelled steel, with suitable perforation for screws, are also used for fixing the ends or fragments of disunited fractures. In certain fractures bolts with nuts may be necessary. For the insertion of screws, pegs, and nails, in addition to an Archimedean drill, an all-metal screw-driver, and perhaps a bone awl, will be required.

After the operation, splinting or some other method of limiting the mobility of the sutured part must be applied so as to prevent undue strain on the suture, which is liable to cause detachment of one of the ends of the fracture or breaking away of the suture.

The writer has on many different occasions had recourse to bone suturing in the dog with, in the majority of instances, the happiest results, the animal having carried the embedded suture many years without manifesting any inconvenience.

In amputation of a limb through a long bone after the superimposed tissues have been cut through, the periosteum covering the exposed bone should be raised in conjunction with the tissues which rest upon or are attached to it, so as to cover the end of the divided bone, after which it is brought over and kept in position with a few interrupted sutures. This periosteal flap, if it becomes adherent to the end of the bone, will preserve it from atrophy and lessen the liability to the formation of a conical stump.

Various Methods of Suturing Operation Wounds

Interrupted Sutures. *Simple Interrupted Suture.*—This is the commonest suture in use in general veterinary practice. It is made by passing a needle carrying suitable material, as silk, through the skin and subcutaneous tissue of the border of the wound, at a distance of a few lines from the edge, according to the size and depth of the wound and the tension of the tissues. The suture is then tied by a reef, or, what is better, a surgeon's knot drawn together sufficiently to approximate the edges of the wound (Fig. 226, *b*) without leaving any puckering of the skin (Fig. 226, *c*).

The knots should be placed at one side or alternately on either side of the line of union, near but not over the suture holes (Fig. 227, B). The distance between the stitches varies according to the animal, the size and situation of the wound, and the gauge of the suture material. Where there is much tension, deeper sutures inserted further from the borders of the wound should be used. These sutures (Fig. 227, A), commonly termed *relaxation*, *approximation*, or *tension sutures*, when carried deeply through all the divided tissues and even those below them, not only relax the tension on the superficial stitches but approximate the deeper layers of the wound and thus prevent "dead-spaces" or sagging of one layer from another. They are also useful where external pressure cannot very well be maintained, as in the groin. Their employment, however, is not as a rule necessary when the various deep layers are brought together by buried sutures.

In small animals where the wound-flap is wide or involves the muscular tissue, the suture may be passed through the whole of the divided tissues (Figs. 229 and 230) and the stitches may be placed alternately so as to involve a slightly greater breadth of tissue, as shown in Fig. 228, which also shows *deep pressure stitches* running in the direction of the wound made in the inguinal region of a male dog for the radical cure of scrotal hernia. This system of suturing gives greater support to the lips of the wound, prevents sagging, and therefore post-operative hæmorrhage, and obliterates "dead-spaces."

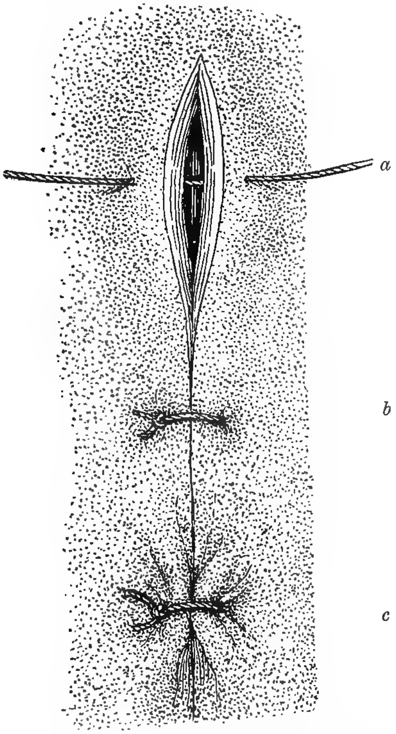

Fig. 226.—Interrupted suture.

a, showing suture in position before tightening it; *b*, after tying (wound properly approximated); *c*, wound improperly approximated by suture being tightened too much and causing puckering.

For the closure of wounds made through the whole thickness of the abdominal wall, as in laparotomy, one layer of interrupted sutures passed through skin, muscular tissue, and peritoneum is sometimes used (Fig. 229); or two layers, one through the skin and the other through the muscular and peritoneal coats (Fig. 231). In the latter case, instead of merely passing the superficial layer through the skin as illustrated by Fig. 231, the suture may be passed through the areolar tissue, underlying muscular tissue, and not under but between the deeper sutures as in Fig. 232. Where three rows of sutures are used to close the wound, the deep or peritoneal opening is generally closed by a continuous suture, the muscular opening with a row of interrupted sutures, and the superficial or skin opening also with a row of interrupted sutures, which may be alternately passed at a greater depth of the skin than the intermediate ones, as in Fig. 233.

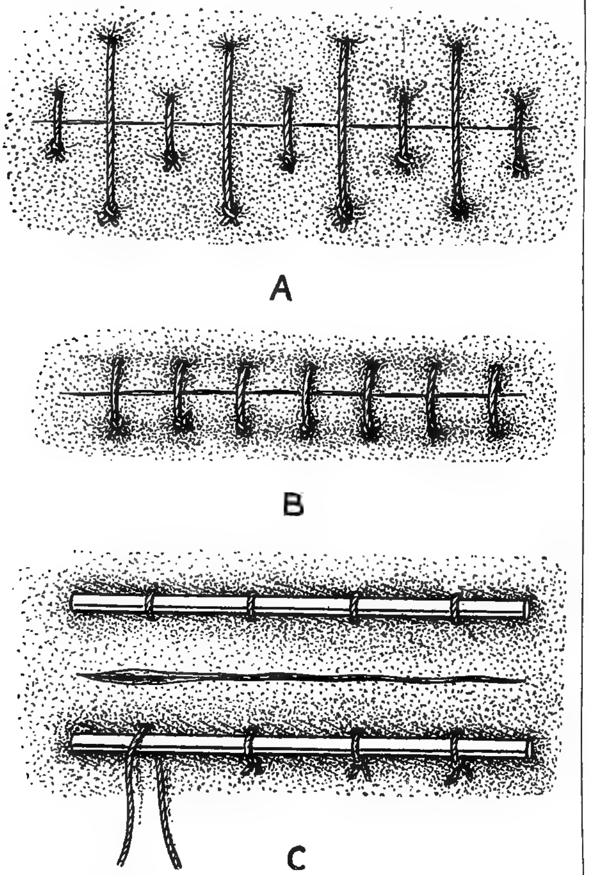

Fig. 227.

A, interrupted sutures alternated with relaxation sutures; B, simple interrupted sutures; C, quilled suture.

Sutures that include more than one layer of tissue maintain the borders of the wound in apposition much better than those which pass through a single layer. This is evident where external pressure in the form of a bandage and dressing cannot be applied, or, if applied, cannot be kept in position in consequence of the movements of the animal. Objection may be urged against using embedded or deep sutures, or of passing one row of sutures over the deeper ones, an objection which is only important when the wound is closed without observing the rules of strict asepsis or antisepsis. Deep sutures favour union by first intention by obliterating "dead-spaces," which form a receptacle for serum or secondary hæmorrhage, and besides they render the part proof against hernia or prolapse.

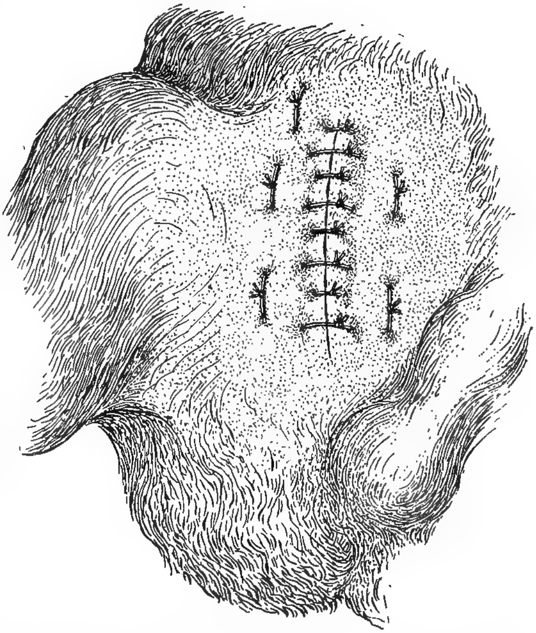

Fig. 228.—Inguinal region of male dog, showing interrupted sutures, passed alternately in different widths, and deep interrupted or pressure sutures taking the same direction as the wound.

The advantage of the interrupted suture over all others is, that if irritation or suppuration supervenes the stitch or stitches can be removed without jeopardizing the approximation of the whole length of the wound. At any time, defective stitches can be removed and fresh ones put in their place. Further, should signs appear of accumulation of blood or pus under the skin there is no necessity to remove all the stitches in order to provide an outlet.

Button Suture.—This is an interrupted suture (Fig. 234) which is usually inserted deeply through the tissues, mostly as a relaxation suture, and instead of the free ends being tied together each is brought through a perforation in a metal disc and fixed. Sometimes the

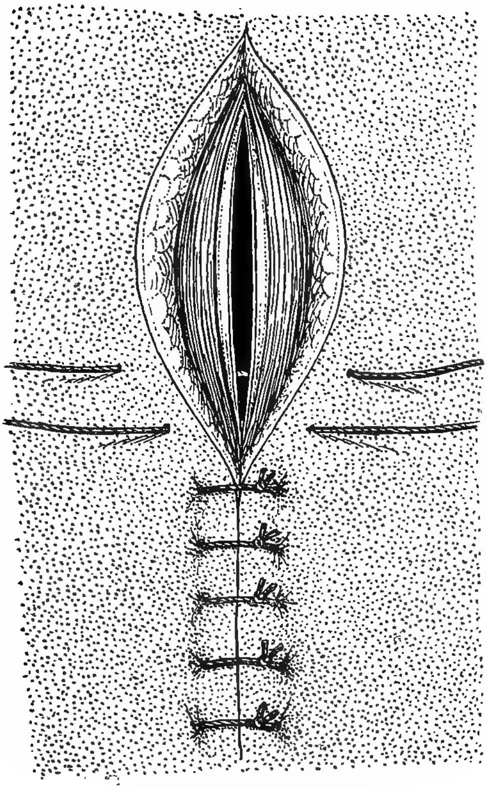

Fig. 229.—One layer of sutures.

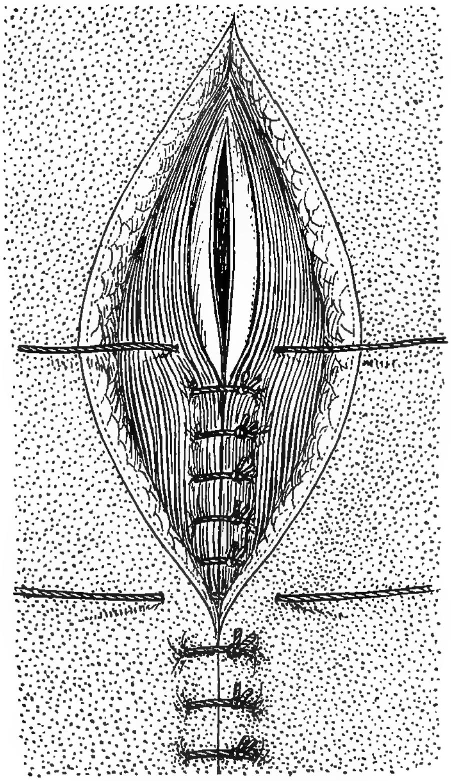

Fig. 231.—Two layers of sutures.

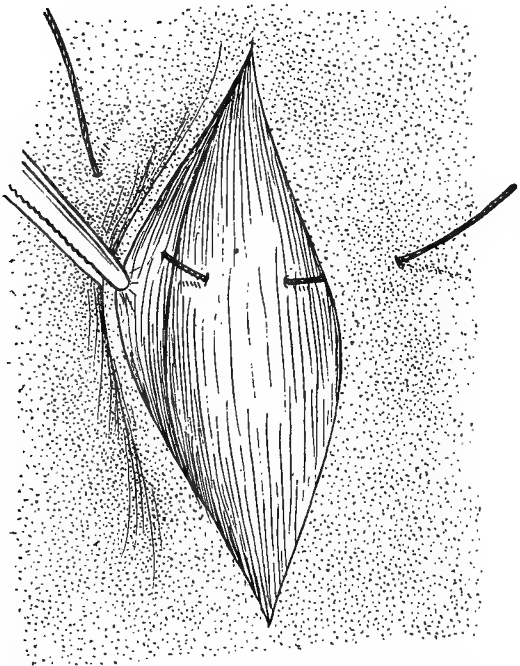

Fig. 230.—Suture passing through the tissues forming the floor of the wound.

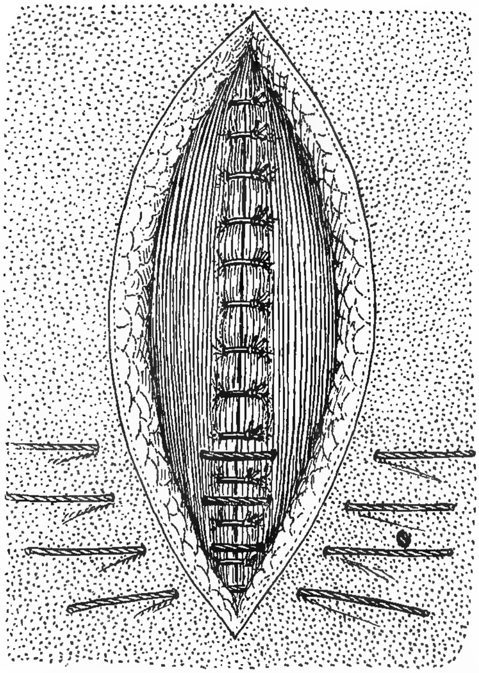

Fig. 232.—Sutures through skin and sutured muscle.

suture material passes twice through each button—the *double button* suture (Fig. 234, *b*). A third form of button suture is that of *Bozeman*, in which the suture ends are fixed on a metallic plate by means of perforated shot. Either wire or silk or other suitable material may be passed through the wound for a button suture. When perforated shot is used instead of a button it takes the name of *shot suture*.

Quilled Suture.—This is made by passing several double interrupted sutures through the lips of the wound, half an inch or more apart, and tying the ends over a quill or rod of wood, aluminium, or whalebone, or a catheter placed on either side in a line parallel to the wound (Fig. 227, c). It is sometimes termed a *compound mattress* or a *clavate suture*. It is useful for deep gaping wounds and in deep vaginal and perineal wounds.

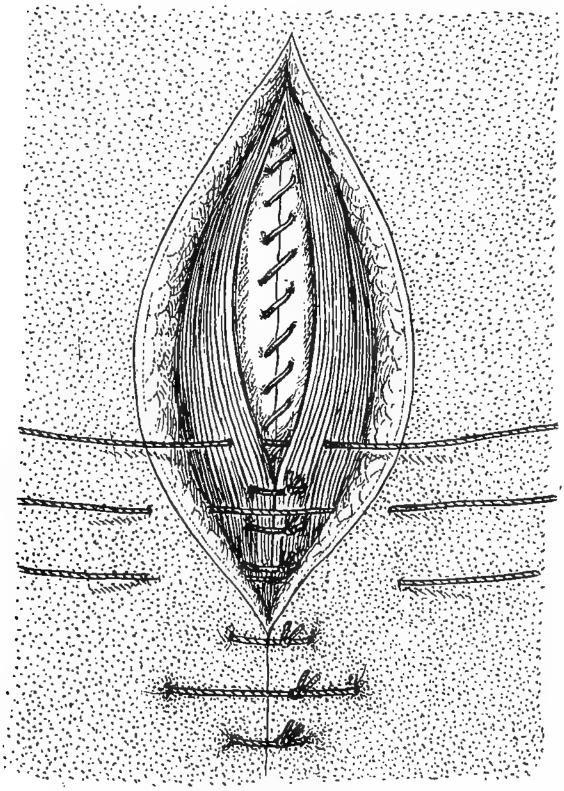

Fig. 233.—Three layers of sutures.

Twisted or Pin Suture, Hare-lip Suture.—This is formed by passing a suitable pin or needle through the lips of a wound and winding thread, silk, horse-hair, worsted, or other material round the free extremities of the pin in an interrupted figure-of-8 manner (Fig. 235). Between the pin sutures small interrupted sutures of silk may be passed through the skin at the edges so as to prevent gaping of the wound. This suture may be made a *continuous twisted* suture by carrying the material from one pin to another throughout the suture line.

In very large wounds, where there is much tension, skewers may be used instead of pins.

The twisted pin suture is chiefly employed for wounds of the eyelid, nostril, and ear, and in the autoplastic operation for broken or blemished knee.

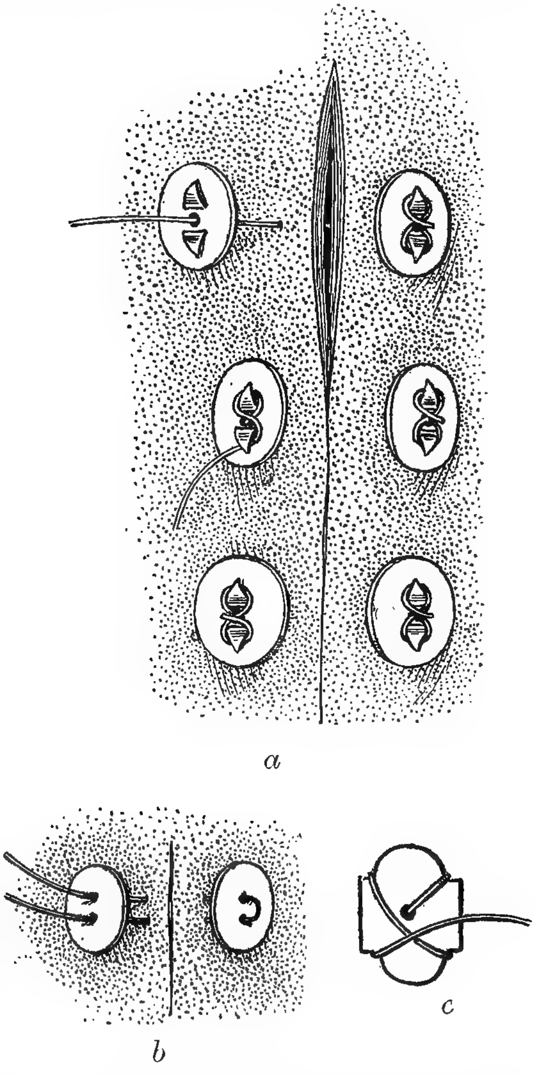

Fig. 234.

a, button suture fixed on Pugh's discs or buttons; *b*, double button suture; *c*, suture button.

Three-cornered Wound Suture.—In an inverted or upright T-shaped wound the two interrupted sutures cross each other (Fig. 236), or a single suture embraces the three lips of the wound so as to approximate them.

Mattress Suture.—This is an interrupted suture made by passing a needle through the tissues in a transverse direction to the wound, and then recrossing so as to form a loop at one side and two free ends at the other which are tied together.

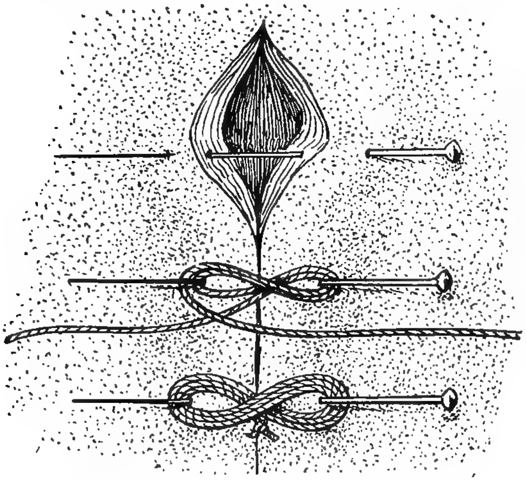

FIG. 235.—Twisted or pin suture.

Continuous Sutures. *Simple Continuous or Glover's Suture.*—This suture is formed by passing a needle furnished with suture material through the divided tissues, securing the first stitch by a knot, and afterwards continuously passing and repassing transversely through the whole length of the wound and finally securing the suture by another knot (Fig. 237). This suture may take an oblique direction under and a straight direction above, or a straight one under the skin and an oblique one above, the wound (Fig. 237). The latter has a tendency to cause a puckering of the skin.

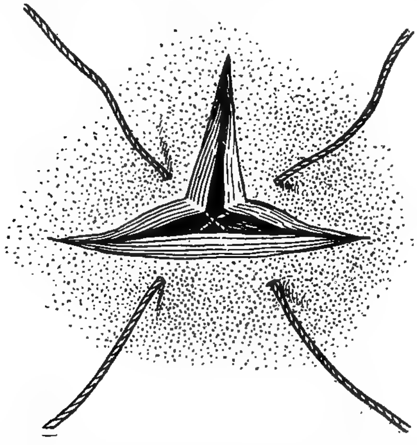

FIG. 236.—Sutures passed through a three-lipped wound.

Blanket Suture.—This continuous suture is made by passing the needle, armed with a suitable thread, through the lips of the wound, and, after each stitch, the thread is held down by the thumb and finger on the opposite side to maintain tension the time the needle passes through the tissues over the thread, in a "half-hitch" manner. The series of "half-hitches" is tightened and maintained at right angles to the wound, whilst the portion between them takes the same direction as the wound.

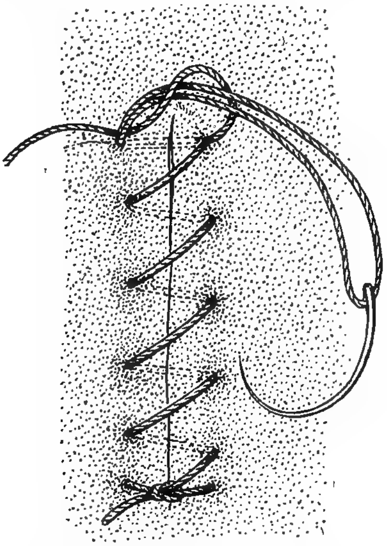

FIG. 237.—Simple continuous suture.

Purse-string or Tobacco-pouch Suture.—This is made by passing the needle through the skin for some distance, drawing the thread after it, and repeating the insertion until the circumference of the circle is complete, when the free ends of the suture thread meet and are tied together (Fig. 238).

This suture is useful when passed round the anus, to prevent recurrence of prolapse of the rectum in the dog, cat, and pig. It is used in connection with Murphy's button and to close up the orifice after resection of the cæcum.

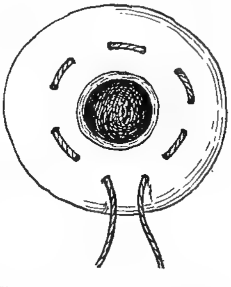

FIG. 238.—Tobacco pouch or purse-string suture.

Subcuticular Suture.—The needle, armed with silkworm gut, fine silver wire, or Japanese silk, is first passed through the skin and then the subsequent stitches are made alternately on either side. The ends are left long and pulled to approximate the wound edges in an accurate manner. When it is necessary to remove the suture one end is seized with a pair of forceps and drawn out a little and cut off; the other end is then seized and withdrawn gently (Fig. 239). It is useful for small wounds and in herniotomy.

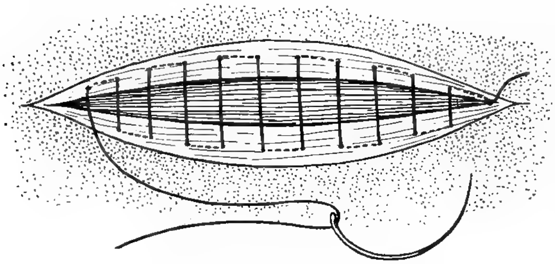

FIG. 239.—Subcuticular suture.

Intestinal Sutures.—In suturing the intestine it is necessary that certain precautions be observed in order that successful results may be obtained. First, hæmorrhage should be avoided, and secondly, irritating or septic material should be prevented entering the peritoneal cavity. These two factors are of especial importance in equine, ovine, and feline abdominal surgery. In all species the coaptation of the divided borders should be made with great care so that they may remain perfectly united. Shock, as far as possible, should be obviated, and the retention of septic and other irritating matter prevented.

Union of incisions in the bowel or of two portions of the viscus may be brought about by suturing alone (*direct method*) or by suturing in addition to the use of mechanical apparatus (*mediate method*). As a rule, union by the direct method takes up much time and thereby increases the liability to shock, and in order to shorten the operation the use of some mechanical contrivance is generally preferred.

The best suturing material is Japanese silk from No. 00, 0, to 1 or 2, or in lieu of this, Chinese twist, which should be rendered aseptic by boiling. Ordinary milliner's needles with not too sharp points may be used. The blunt-pointed needles used by harness makers and other leather workers are also suitable.

Lembert's Suture.—This is an interrupted suture which passes through all the coats of the bowel with the exception of the mucous membrane. The needle passes through the wall for about $\frac{1}{6}$ to $\frac{1}{10}$ of an inch from the lip of the wound on either side. The sutures should extend beyond each extremity of the wound. When the ends of the sutures are tied the serous surfaces are brought in contact by inversion of the lips of the wound (Fig. 240, B and C).

Czerny-Lembert Suture.—This is similar to the last, with the addition of a second superficial layer of sutures made through the sero-muscular coats above those of the first layer, so that when drawn together and tied the first layer becomes buried. Originally Czerny's first layer of sutures were passed through all the coats, including the mucous membrane (Fig. 241).

Chaput's Sutures, or *Sutures by Abrasion.*—There are three methods by which these may be inserted. Along the whole extent of the wound for about $\frac{1}{3}$ of an inch in width the mucous membrane is separated from the muscular coat. After excision or invagination into the intestine from the detached part, the first layer of interrupted sutures is passed through but *not penetrating the whole thickness* of the mucous membrane of the lips of the wound. A second layer of sutures is then passed through the serous and muscular coats. By this method the lips of the mucous membrane are inflected (Fig. 242). By the *second* method the sutures pass right through the mucous membrane so that when tightened the lips are in apposition.

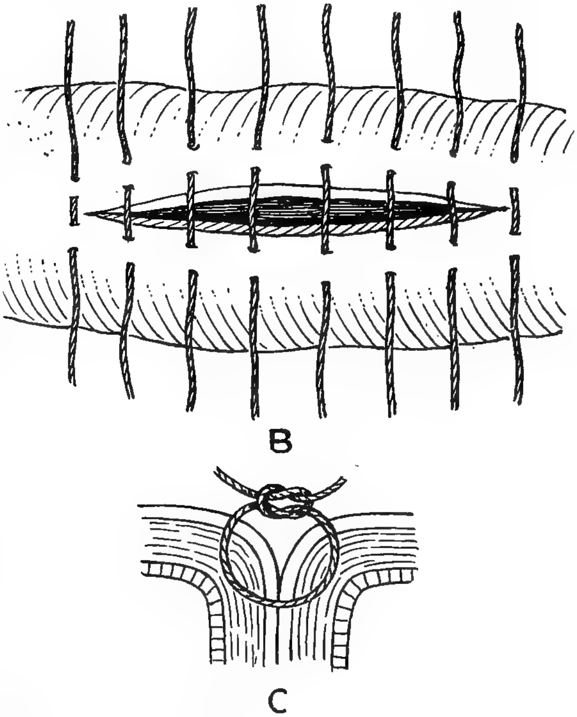

FIG. 240.—B, Lembert's suture; C, Lembert's suture tied.

In the *third* method, beyond the suture by abrasion, there are two layers of sutures one above the other, opposing serous membrane to serous membrane.

Wölfler's Suture.—This is made from the inner side and carried through all the coats of the bowel, bladder, or stomach. It is serviceable in closing a wound in the attached portion of stomach or bowel (Fig. 243).

Halstead's Mattress or Quilt Suture.—This is made in a similar manner to that of Lembert, but a loop is formed at one side of the wound with the two free ends at the other, resembling in form a hairpin. The free ends are tied together. It includes the submucous membrane.

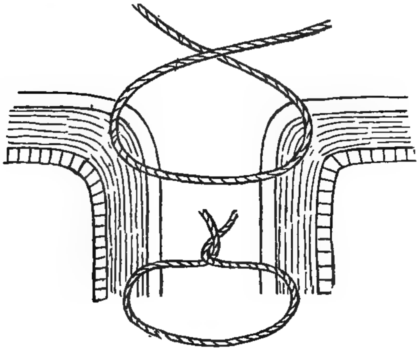

FIG. 241.—Czerny-Lembert suture.

Jobert's Suture.—This is an interrupted suture passed through the whole thickness of an inverted portion of bowel and then carried through, from above downwards, the opposite lip of the wound and afterwards from within outwards in the inverted portion so as to approximate the serous surfaces in the operation of invagination for circular union of a divided bowel (Fig. 244).

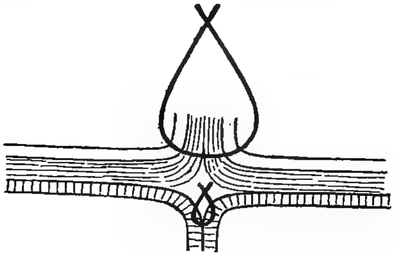

FIG. 242.—Chaput's suture.

Dupuytren's Suture.—This is a continuous suture passed in a similar manner to that of Lembert, but the suture material crosses the wound in an oblique manner.

Cushing's Suture.—This is also a continuous suture. It includes the submucous membrane. The suture crosses the wound at right angles, but the needle is so passed through the bowel that it takes a direction parallel to the wound. When it is passed through the other side and drawn together it inverts the edges of the wound so as to approximate the serous surfaces.

Tendon Sutures.—Divided tendons are united by sutures, but there must be an entire absence of hæmorrhage to obtain satisfactory results. There must be complete antisepsis, else there will be failure in reparation and perhaps a destructive inflammation of the sheaths of the tendons and surrounding tissues. Divisions of some standing as well as recent ones respond to treatment; but the sooner they are brought together the better, as the longer they are left the greater the difficulty in uniting them. When more than one tendon is divided in a wound care should be taken to unite the two parts of the same tendon.

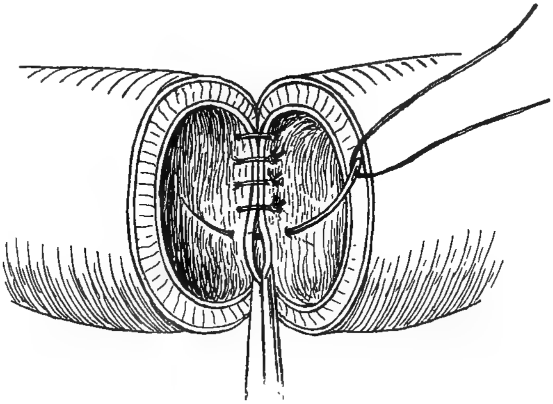

FIG. 243.—Wölfler's suture.

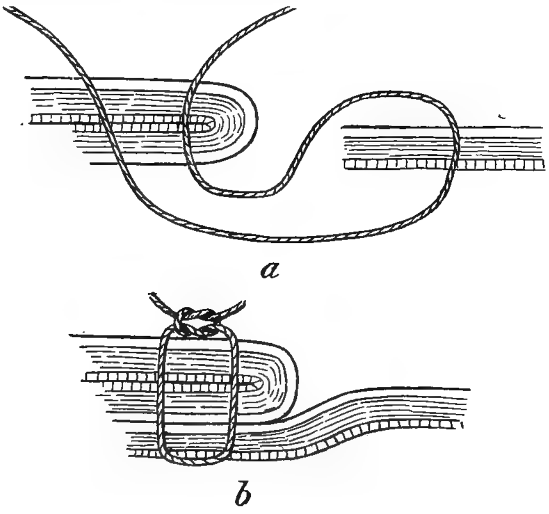

FIG. 244.—Jobert's suture.

There are several methods of suturing the divided ends of tendons. In the simplest, the suture is passed through one end of the tendon and then through the other end; in both cases about a quarter of an inch from the cut surface, and the free ends of the suture are drawn together until both cut ends of the tendon are approximated, and then tied in a knot. Another suture of a similar kind may be passed so as to cross the first suture; or it may be made in a parallel direction. The quilted suture is made by passing the needle twice in and out of the lateral surfaces of the tendon above and below the division and then tying (Fig. 245). Another method is to pass several sutures through the sheath of the tendon. Small supplementary sutures may be passed through the lips of the wound between the deeper sutures. In oblique divisions the sutures are carried in a transverse direction through the divided extremities. Where there is loss of a portion of tendon from injury or inflammation, or even a contraction without any loss, lengthening may be tried by autoplastic operation.

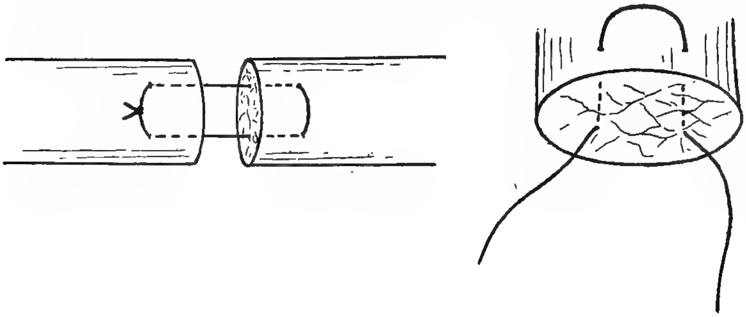

Fig. 245.—Quilted or mattress suture for tendons.

Chromicized catgut, kangaroo, or reindeer tendon, fine silk or silver wire may be used for the union of tendons.

Nerve Sutures.—Divided nerves may be sutured by methods similar to those adopted for divided tendons. For *recent* division with no loss of nerve-tissue the extremities may be brought into apposition with a couple of fine catgut or silk sutures passed with a round needle and then tied. The sutures should be made as near to the surface of the nerve as possible (Fig. 246, *a*). They may be made through the sheath only (Fig. 246, *b*). Tension of the nerve at the opposing cut surfaces must be avoided.

For divisions of *old* standing resulting in loss of function and atrophy, the nerve ends must be exposed, stretched, and the cicatricial tissue removed. Thin sections are removed from the bulbous extremity until normal nerve-tissue is exposed. The lower end is also, but slightly, dealt with in a similar manner. The two extremities are then brought together by three or four fine sutures passed through the nerve at about an inch from the divided extremities and tied. Where there is a loss of nerve-tissue, leaving a gap between the two divided ends, it may be repaired by an autoplastic operation.

As suture material fine catgut, kangaroo tendon, or silk may be used. Needles similar to those recommended in bowel suturing should be employed to carry the suture material. Needles with sharp points or cutting lateral surfaces should be avoided.

Artery and Vein Sutures.—In the case of partial or complete division of large vessels, especially the main ones in the limbs, it may be necessary to approximate the divided ends so as to restore circulation to the parts supplied by them.

Sutures similar to those of Lembert in intestinal surgery are made, care being taken not to penetrate the endothelial lining. Sutures should also be passed through the areolar sheath of the vessel so as to give the sutured part support. Before attempting suturing it is necessary to shut off the blood supply by temporary ligation or clamping of the vessel above and below the wound, care being taken in doing this that the inner lining of the vessel is not injured.

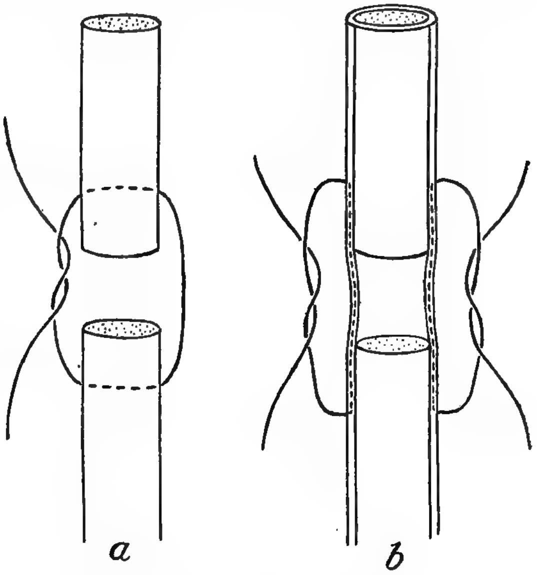

Fig. 246.—Nerve sutures.

a, simple suture; *b*, suture through sheath of nerve.

Suture and Ligature Materials.—The object of suturing wounds is to hold the divided tissues in apposition until reparation by cell proliferation has taken place. Sutures should not be too tight, or strangulation of tissue may result. Suture material should be sterile and non-irritating. It should be sufficiently strong to withstand strain without breaking during manipulation.

As a general rule, absorbable suture material should be used in deep suturing, and that employed for superficial sutures, which will be removed ultimately, should be of the non-absorbable class. The latter is, however, less likely to carry infection, because it can be rendered more completely sterile.

Organic Suture or Ligature Material. 1. **Absorbable Suture or Ligature Material.**—*Catgut,* which is prepared from the small intestine of the sheep, and not as its name implies from the cat, is sold in various sizes, viz. 00, 0, 1, 2, 3, and upwards, is rarely nowadays purchased in an unsterilized condition, but one should be careful of the repute of the commercial house from which it is procured, as some specimens are very unreliable so far as sterility is concerned. It may be procured in three forms, viz. plain, chromicized, and iodized.

Plain catgut is more rapidly absorbed than the chromic, and as it is more pliable it is easier to tie than the chromic, which can stand more strain and does not become absorbed so quickly.

Chromicized catgut is hardened with a preparation containing potassium bichromate. No. 2 size is used for ligating bleeding vessels divided during an operation, whereas plain catgut is mostly employed for ligating pedicles and the omentum. The No. 3 size is used for holding the divided ends of a large muscle together.

Iodized catgut is sterilized by immersing catgut in iodine, which, however, weakens its power to resist great strain. It is pliable and easily handled.

Kangaroo tendon is made from the tendon of the kangaroo. As it will not withstand heat it has to be sterilized by immersion in antiseptic liquids. It must not be boiled with the instruments.

Reindeer tendon is prepared from tendons obtained from the reindeer, and is sterilized in a manner similar to that of kangaroo tendon. Sutures of tendon are used in those conditions where prolonged immobilization of wounded parts is indicated, as in maintaining fragments of fractured bones in position and for ruptured tendons.

Tendon is slowly absorbed and does not seem to have much advantage over chromicized catgut.

2. **Non-absorbable Suture and Ligature Material.**—*Silk-worm* gut is the fibre or gut withdrawn from the silkworm killed when it is about to spin its cocoon. It is smoother than silk and is more readily cleansed. It is not absorbed, but it is said that it is less liable to cause a stitch abscess than silk. It has no value as a ligature because, in consequence of its stiffness, it cannot be tied in firm knot. In its finer sizes it is sometimes used in place of horse-hair.

Silk is used both for suturing wounds and ligating blood-vessels. For these purposes it is sold in two forms, the twisted and the braided. It is readily sterilized, easily applied, and makes a firm knot. It is not absorbed and may be readily infected.

The Japanese have put on the market a high quality of suture silk which has been found very reliable in practice.

Silk may be sterilized by boiling with water containing 1 per cent of bicarbonate of soda for ten minutes, or keeping it for some time in a 10 per cent solution of carbolic acid. It cannot withstand repeated boiling without becoming brittle and losing its tensile power.

Silk is distinctly useful in abdominal surgery. It is sold in sizes from Nos. 00, 0, 1, 2, 3, 4 and upwards.

Pagenstecher's (*celluloid*) thread is made of fine hemp dipped in a solution of celluloid and is sold in hanks. It is smooth, very strong, easily handled and readily rendered sterile. It does not lose its stiffness or hardness even when kept in sterilized solutions for years, and therefore does not unravel as does silk when exposed to similar conditions. It is very cheap, relatively stronger than silk, and allows a firm knot to be made. It is largely used in place of silk in abdominal surgery. For external sutures in veterinary practice it is far inferior to silk, as it causes more irritation and often sets up stitch suppuration.

Linen thread in the form of a hard twisted black Irish linen, as well as ordinary linen sewing thread, is used in place of silk in abdominal surgery. It is sterilized in a manner similar to that of silk.

Wax Thread.—Both Pagenstecher's and other linen or hemp threads may be waxed by putting them in melted paraffin wax, after they have been soaked in ether or oil of turpentine. They are then drawn through a clean cloth to free them from superfluous wax. This form of thread is supple and does not imbibe organic liquids or unduly cut the tissues.

Horse-hair removed from the tail of the horse may after it has been washed in soap and water and sterilized by boiling for an hour, be used as a suture material for wounds of the eyelids, mouth, and lips.

All these organic suture or ligature materials may be procured in a sterilized form put up in containers in which they are kept ready for use when required.

Inorganic or Metallic Suture Material.—*Silver wire,* which may be procured in various gauges, is the best of this class for suturing purposes. It is used where sutures are required to be maintained in position for some time, such as in deep wounds of the abdominal walls, wounds in the roof of the mouth, torn eyelids, fractured patella, and in disunited fractures.

Polished or plated iron wire, as used by florists and bottling merchants, may be utilized under similar conditions and is just as effectual as silver wire.

Leaden composition wire is an excellent suture material for large and autoplastic wounds in horses and cattle. It is very soft and pliable and can easily be twisted with the fingers. It causes very little, if any, irritation. It has the advantage of being readily untwisted where one wishes to examine the depths of a wound suspected of undergoing suppuration. In case of a very large gauge wire being necessary for a relaxation suture in deep and wide muscular wounds, such as those sometimes found on the haunch where the skin is tough and thick, the hollow or tubular leaden composition cable wire, as used by electricians or telephone mechanics for soldering purposes, is very suitable as it is light and pliable. The lumen or hollow centre contains resin, but this is no disadvantage.

These composition wires, which require special needles with a tubular distal end for carrying them through the tissues, of which Reek's pattern is a good example, are often used by practitioners to close the wound after removal of a testicle accompanied by a more or less slight inguinal hernia, in order to obviate prolapse of the viscus.

Zinc binding wire, which is fairly pliable, may also be used for large wounds in which there is much tension or strain.

All these metallic sutures should be rendered sterile by boiling for half an hour in water containing soft soap, after they have been polished in order to remove all traces of oxidation. They may then be immersed in a 5 per cent solution of lysol until used for suturing.

Pins are often used to close certain wounds where pressure is required, as wounds carried through the whole thickness of the eyelid, nostril, and lip. They are also used in certain autoplastic operations such as cleft lip, cleft eyelid, removal of indelible scars from the knees, and also for the closure of the cutaneous wound in the operation of phlebotomy. In the method of arresting hæmorrhage by acupressure they form one of the necessary requirements. The pins used for this purpose are the hare-lip pin, the blanket pin, and the bead-headed pins, sold by linen drapers for domestic purposes. They assist in the formation of a continuous and also of an interrupted twisted suture. After insertion the sharp point should be removed by a pair of wire-cutting nippers (Fig. 247).

Nickel-plated steel safety pins are useful for keeping rubber drainage tubing in position at the mouth of the wound and for passing through the walls of the anus or the vulva to retain the replaced prolapsed viscus. For the larger animals they require to be of a suitable or special size. They may also be used for closing the abdominal opening after the replacement of herniated viscera, and in addition for passing through the skin and sub-lying muscular tissue to maintain pressure of the flap so as to avoid sagging and in consequence "dead-spaces" in a wound where external pressure cannot be very well effected.

Steel skewers are often utilized for closure of large abdominal openings through which a portion of the viscera has escaped from the abdomen forming an abdominal hernia. They are either passed through the muscular coats surrounding the breach or merely through the skin and subcutaneous tissues forming the sac of the hernia. They are used in conjunction with light metallic clams or cord, and left *in situ* until the incarcerated tissues have sloughed off.

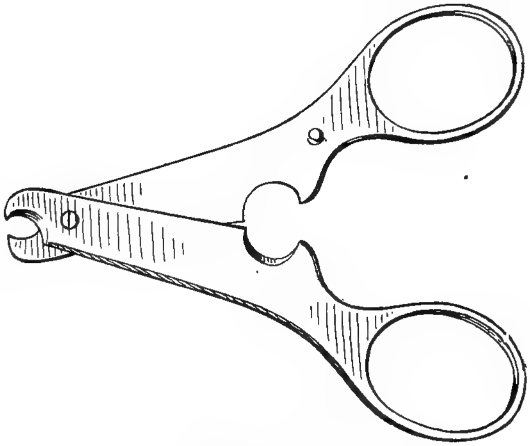

Fig. 247.—Wire-cutters.

Metallic buttons, composed of either lead, zinc, aluminium, or a metallic composition, are used to assist in the formation of the button-suture. Pugh's pattern is a very good one for this purpose.

Iron screws with sharp points, as used in joinery, are sometimes used to keep in apposition broken fragments, as in fractured patella, and also the disunited ends of the bone, in oblique fracture. The sizes usually used are from $\frac{1}{2}$-$\frac{5}{8}$ to 1 inch.

Electro-plated T *and* ▯ *iron plates* with several perforations for the passage of screws are useful for maintaining fragments of bones, and the separated ends of bones that cannot be maintained in position by splints and bandages, in a state of approximation until reunion has taken place. Unless they cause irritation or suppuration they are not removed after the fracture has united, but left in position where they undergo gradual disintegration.

Hæmostasis, or the Control of Bleeding

From whatever source the bleeding may arise, unless prevented or checked it obscures the vision of the surgeon during the operation, and unless removed before the wound is closed it forms, in the absence of strict asepsis or antisepsis, a suitable medium for the development of bacteria. It may prevent healing by first intention, or it may endanger the life of the animal either from infection or from loss of blood.

The three principal sources of hæmorrhage are the arteries, veins, and capillaries.

From the Arteries.—In arterial or active hæmorrhage the blood spurts out some distance in a jerky or intermittent manner from both ends, more from the proximal end than from the distal end of the divided vessel. The blood, which is of a light-red colour, is checked when pressure is applied to the vessel above the bleeding-point.

From the Veins.—In venous or passive hæmorrhage, the blood, which is of a dark-red colour, flows continuously without spurting from the distal end of a divided vein. Pressure below this point of the vessel checks the bleeding.

From the Capillaries and small Vessels.—Capillary hæmorrhage so-called does not alone flow from the capillaries but also from arterioles and venules. The blood continuously oozes until it ceases spontaneously in a short time.

Bleeding takes the name of *primary hæmorrhage* when it appears immediately or soon after an injury. Should it recur within twenty-four hours after primary bleeding has ceased it is then denominated *recurrent* or *reactionary* hæmorrhage, and is due to dilatation set up by exertion which increases the action of the heart, or to the giving way of a ligature. When the bleeding appears several days after an injury it is said to be *secondary*, and is probably set up by the disintegration of the clot or to septic infection of the tissues surrounding the end of the artery.

Rational Arrest of Hæmorrhage.—This takes place in nature by the coagulation of the blood, which increases and is due to alteration of the blood itself, as it flows; by diminution in the force of the heart's action, which is produced by the loss of blood; and by changes which take place in and around the vessel itself, such as retraction of the vessel within its sheath, contraction of the divided ends, and the formation of a coagulum within and around the orifice. These means may in the first instance temporarily arrest hæmorrhage and afterwards act permanently. Therefore the customary practice of the layman of washing away the blood from accidental wounds and of giving a stimulant is of no advantage. Exercise or movement of any description stimulates the blood-flow and therefore should be avoided. Hæmorrhage from a vessel partially divided transversely, longitudinally, or obliquely may be profuse, but it generally lessens or ceases after complete division of the artery.

The spontaneous arrest of hæmorrhage from small vessels is best seen in young, healthy, vigorous animals. In old debilitated and in young anæmic and flabby animals the natural powers of overcoming bleeding are enfeebled, either from a lowered vitality of the vessels themselves or from a deficiency of the fibrinogenous elements in the blood.

Preventive or Pre-operative Hæmostasis.—The prevention of hæmorrhage is chiefly applicable to the limbs and tail, and may be carried out by means of a *tourniquet* applied around the member and fixed so as to compress the vessels.

The *tourniquets* principally used for this purpose are composed of rubber tubing or cord from 18 to 20 inches in length, provided with a hook at one end and a chain at the other (Esmarch's); with a hook at one end and a ring (Rossignol's), or a loop at the other (Leeney's, Fig. 248, C); or a block of boxwood or vulcanite with a hole or canal piercing its whole length, through which the rubber tube or solid rubber cord passes, and one or two longitudinal channels on its upper surface to fix either one or both free ends of the rubber (Foulis's, Fig. 248, A and B); or an anchor at one end to which the free end is hitched and maintained in position by tension of the rubber tubing after it has been wound round the limb in a state of tension two or more times (Samway's, Fig. 248, D). It is not necessary to have any one of these patterns, as a suitable length of rubber cording or tubing ¼ to ½ in. in diameter wound round the limb and the free ends tied together in a knot will answer the purpose quite as well.

The tourniquet may be applied above the elbow, knee, fetlock, coronet, or hock in the larger animals, and in the smaller animals near the shoulder and hip-joints as well as any other part below these regions.

The narrow-calibre rubber tubing should not be maintained in position too long, as it is liable to injure the underlying vessels, nerves, and tissues, and may induce necrosis.

The tourniquet should not be removed until

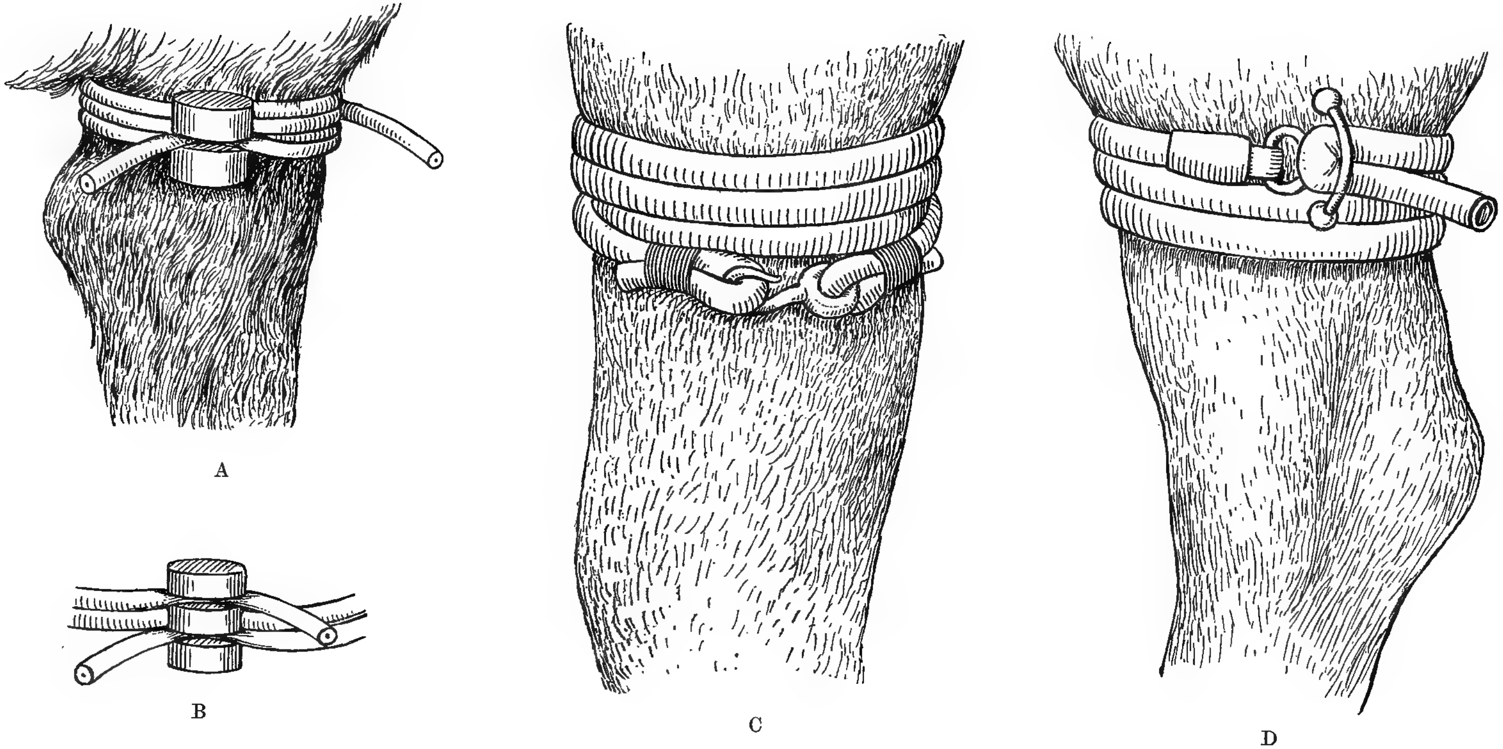

FIG. 248.

A, Foulis's single grooved tourniquet applied above dog's elbow.
B, Foulis's double grooved tourniquet.

C, Leeney's tourniquet applied above horse's knee.
D, Samway's tourniquet applied above horse's hock.

the operation is completed by ligature of the arteries, the wound sutured, or a compressive antiseptic dressing applied. In the case of certain operations it may be advisable not to remove the tourniquet until the animal regains its feet, when the compressive dressing may be applied and afterwards the tourniquet removed. If the compressive antiseptic dressing is properly applied very little reactionary hæmorrhage results.

Unless the tourniquet be properly applied, the hæmorrhage during an operation is likely to be more profuse than without it. Moreover, the limb should be raised so as to drain the veins before it is fixed else on incision some venous bleeding may occur. To render an operation absolutely bloodless, Esmarch in 1873 introduced the rubber bandage, which he firmly wound round the limb, commencing at the extremity and allowing each turn of the bandage to overlap the previous one. The bandage during its application was kept in a state of tension so as to force the blood up to the trunk, and was carried up to the region to which the tourniquet was applied, and only removed when the tourniquet had been secured. This method was introduced into veterinary surgery in English-speaking countries by Major-General Sir F. Smith, who used it in neurectomy operations. It is a valuable adjunct in operations where the skin and underlying tissues are extremely vascular due to inflammatory changes set up by vesicants and other causes; also in operations on the limbs of the smaller animals. It has been used with success in excision of the prolapsed uterus in the larger animals. Where local anæsthesia is adopted this method of artificially producing ischæmia increases and prolongs the action of the anæsthetic, partly by its benumbing effect and partly by preventing a rapid diffusion of the drug. It also prevents rapid intoxication. Unless the tension of the tourniquet when it is being applied be continuous, so as to compress at once both the arterial and venous circulation, venous stasis will be effected before the arterial flow is arrested, and when an incision is made there will be a flow of venous blood into the wound.

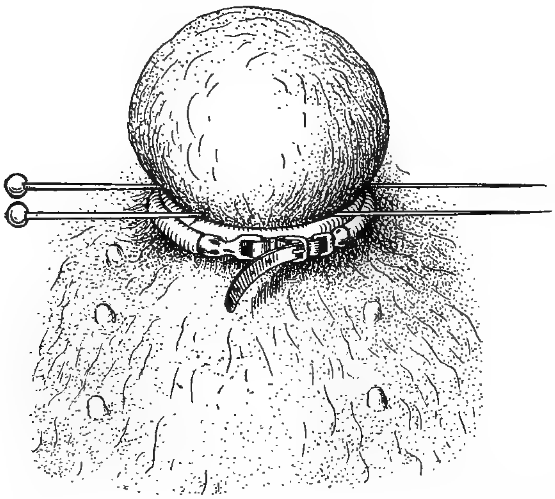

Fig. 249.—Smith's tourniquet kept in position by means of steel pins at the base of a loose sub-abdominal tumour in the dog.

The tourniquet may be used with advantage in conjunction with long steel pins passed through the tissues to keep the rubber from slipping, as in certain positions on the fore and hind limbs and also in operations for the removal of loose subcutaneous tumours with the object of producing ischæmia. The writer has adopted this method with success in suturing the ends of ununited fracture of the femur and humerus, and found it of service in rendering bloodless operations made above the elbow-joint and the upper two-thirds of the tibial region.

Digital or *mediate compression* with the fingers of the chief arterial trunks supplying the operative zone with blood is rarely used, unless in those parts where other methods of pressure cannot be maintained. It may, however, be applied to arteries or veins divided during an operation.

Keeping an animal without food and water for twenty-four hours before operation reduces the liability to free hæmorrhage. This is a very old practice with pig spayers and gelders, and experience proves it is well founded.

Arrest of Hœmorrhage during and after an operation is carried out by various means, such as the actual cautery caustics, plugging, pressure, heat, cold, styptics, forcipressure, torsion, and ligature.

Hœmostasis by actual Cautery.—This is one of the most ancient methods of arresting hæmorrhage and is still in vogue, especially in rural practice, where it is difficult to keep the patient under close professional observation. Various patterns of irons as well as thermocauteries are used in applying the heat. (*Vide* "Actual Cauterization.")

The iron should be heated to a dull-red or even not beyond a black heat, as a white-hot iron chars the divided ends of blood-vessels and leaves them as rigid tubes through which the blood can still escape, whereas the dull-red iron coagulates the albumin of the vessel walls and even the blood itself, which acts as a plug to the curled-in inner and middle coats of the vessel wall. Its action is best observed where hæmorrhage is arrested by clams or forceps and the effused blood is removed before the iron is applied. In presence of extravasated blood the iron quickly cools and is less likely to have the desired effect on the vessel walls.

Hæmostasis by the potential Cautery.—The best-known potential cautery is solid nitrate of silver, which is suitable for arresting small hæmorrhages from superficial wounds or the edges of the divided skin. It acts more effectually when bleeding is first arrested by gripping the oozing surface between thumb and finger or by forceps and wiping away the effused blood before applying the caustic to the wounded surface. Other caustics having a similar action are chloride of zinc, terchloride of antimony, sulphate of copper, alum, pure carbolic acid, and sulphate of iron. They coagulate albumin and cause a more or less thick scar which closes the orifice of small vessels.

Forcipressure.—This form of arresting hæmorrhage is performed by compression of the divided blood-vessels with forceps. It is one of the quickest methods of checking bleeding during the performance of an operation. Continued pressure for a short period is sufficient to arrest hæmorrhage of the smaller vessels, but the larger vessels should be ligated before the forceps are removed. In situations where it is difficult to ligate, the forceps may be left *in situ* for twenty-four hours, when they may be carefully removed without any fear of a recurrence of the bleeding. During the operation the hæmostatic forceps may be left attached to the vessels, and after it is finished and before sutures are inserted through the skin they may be removed after ligating the larger or bleeding vessels. Various types of artery or forcipressure forceps, such as the patterns of Pean, Spencer Wells, Doyen, Kocher, Halstead, Lawson Tait, Greig Smith (Fig. 250) and Shoemaker (Fig. 251, *c*) are useful for the purpose; they have straight, minutely-grooved jaws, angular on the side or on the flat (Fig. 251). They vary in length from $4\frac{1}{2}$, 5, 6, to 7 inches. Some artery forceps have T-shaped jaws which are either straight, angular, or slightly curved (Fig. 250).

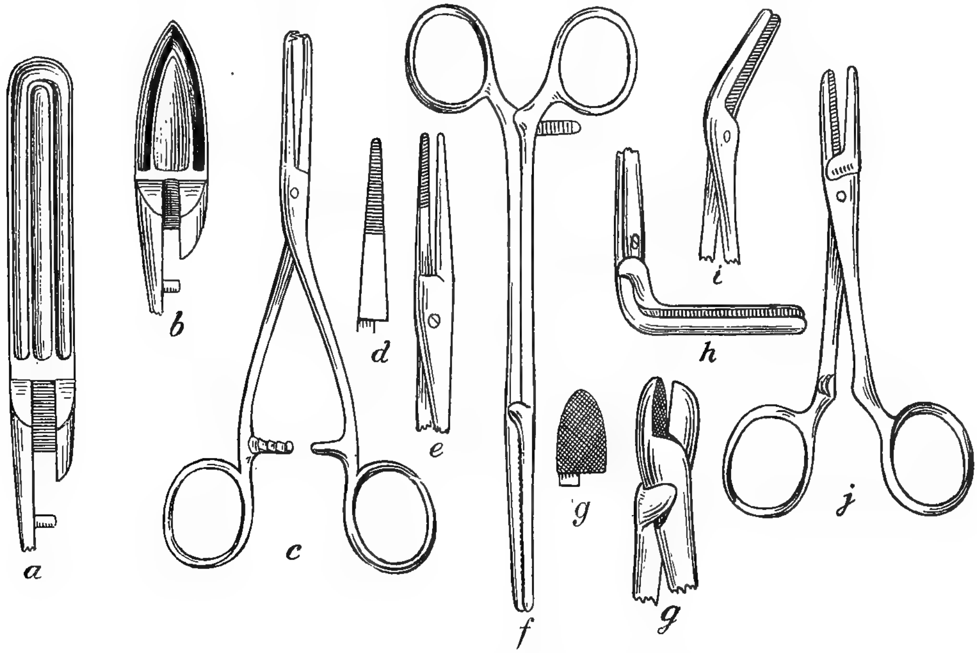

FIG. 250.—Various artery forceps.

a, *b*, and *c*, Greig Smith's artery forceps; *d*, Kocher's forceps; *e* and *f*, Halstead's forceps; *g* and *j*, Spencer Wells's forceps; *h* and *i*, Doyen's forceps.

Torsion.—This may be unlimited or free torsion, which is carried out by seizing the vessel, usually a small one, with the forceps and twisting it around a few times until its resistance is overcome. Or *limited torsion*, for which two pairs of forceps are required (Fig. 252). With one the vessel is seized and drawn out for a short distance, when the other pair is applied transversely so that when the forceps holding the end of the vessel is twisted a few times the pair below limits the torsion to that part of the vessel above it. The inner coats of the vessel are torn, which promotes clotting of the blood in the twisted portion.

For castration several torsion forceps and apparatus have been invented for the twisting of the testicular cord *en masse*.

Ligation.—This is one of the surest and safest methods for the arrest of hæmorrhage from large vessels, but for the ligaturing of the spermatic vessels in the castration of the horse it is objected to in consequence of many fatal results due to tetanus accompanying this method.

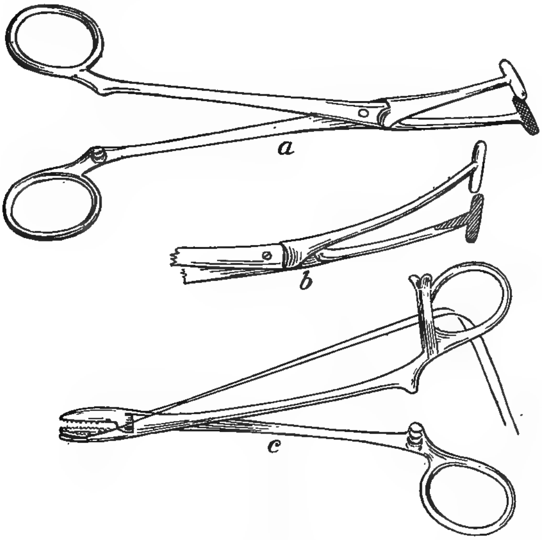

Fig. 251.

a, *b*, clamps or artery forceps; *c*, shoemaker's artery forceps and ligature carrier.

Probably such untoward consequences are due to the catgut usually used being infected with the tetanus bacillus. With the chromicized or iodized catgut applied in an aseptic or antiseptic manner such accidents ought not to happen, especially if the scrotal wound be sutured under antiseptic precautions.

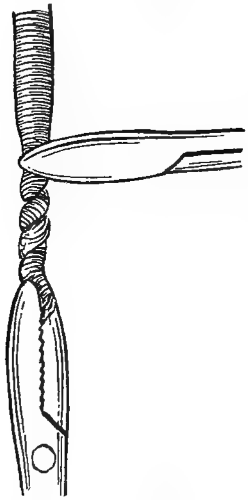

Fig. 252.—Limited torsion.

The condemnation of this procedure should be due rather to the way it is carried out than to the method. The vessel is seized by a pair of hæmostatic forceps, then drawn a little way from the surrounding tissues and afterwards tied firmly with the first portion of a reef or surgeon's knot before the forceps are removed (Fig. 253). The second portion of the knot is then completed and the ends of the ligature cut closely to the knot. When catgut is used it is better to use a reef knot (Fig. 254, A) in order to obviate the danger of the knot becoming loose owing to the swelling of the catgut and opening of the knot. A granny knot (Fig. 254, B) should be studiously avoided. If other tissues are included in the ligature the knot must be more firmly applied, or the ligature should be passed through the tissues around the vessel by means of a needle and then tied (Fig. 255).

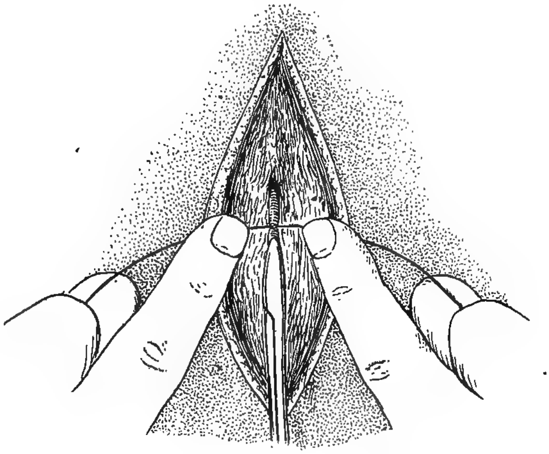

Fig. 253.

This latter mode of ligaturing is useful in tying the spermatic artery, mesenteric, omental, and other vessels not easily reached by the ordinary methods. It will prevent the ligature slipping, and thus obviate the risk of secondary hæmorrhage. Vessels in continuity with their normal relations requiring ligation are raised by an aneurism or neurectomy needle, which is then threaded with a ligature and afterwards withdrawn, pulling the ligature under the vessel, which is ultimately tied firmly.

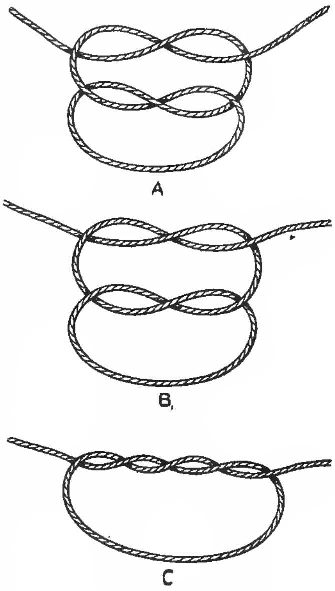

Fig. 254.

A, reef knot; B, granny knot; C, surgeon's knot.

Where an important vein is cut in a small wound the vessel is seized with a pair of forceps and withdrawn in the form of a cone and then tied with a ligature. If the wound be large both ends of the vessel must be ligated.

Ligation en Masse.—This intermediate method of ligation is useful where it is impossible to isolate the vessel from its surrounding tissues. A round-bodied, half-circle, curved needle armed with fine Japanese silk is passed through the tissues so that the vessel is included in the ligature and tightened sufficiently to arrest the bleeding (Fig. 256).

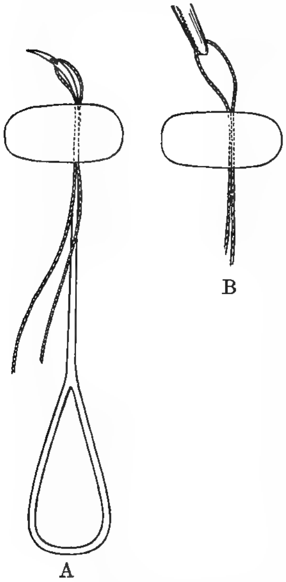

Fig. 255.

A, needle armed with ligature passed through stump; B, ligature in position, ready to be drawn through.

Lateral ligation may be had recourse to in the case of an important vein. The injured part of the vessel is seized with a pair of forceps and drawn out into a fine cone, and a ligature of fine Japanese silk is then tied around the base of the cone. In case it cannot be ligatured, a few interrupted suture points may be passed through its outer coats; or even the ordinary pin suture used, as in the case of the cutaneous incision made in jugular phlebotomy.

Acupressure.—This method of arresting hæmorrhage is carried out by passing an acupressure needle or pin through the soft tissue at one side of the vessel, then under the vessel, and then through the soft tissue at the other side, and bringing a ligature over the vessel and tying it at both extremities of the pin. The other method is to pass the pin through the soft tissues and over the vessel so as to exert slight pressure on the vessel. If the pressure is not sufficient the pin is passed obliquely through the soft tissue at one side of the vessel, twisting it to a straight line, and then passed through the soft tissue at the other side. In superficial veins punctured in phlebotomy, such as the jugular vein, the vessel is closed by passing a steel pin deeply through the lips of the skin wound, which are then maintained in position by twisting a piece of silk, horsehair, tow, or cotton in a figure-of-8 fashion (Fig. 257).

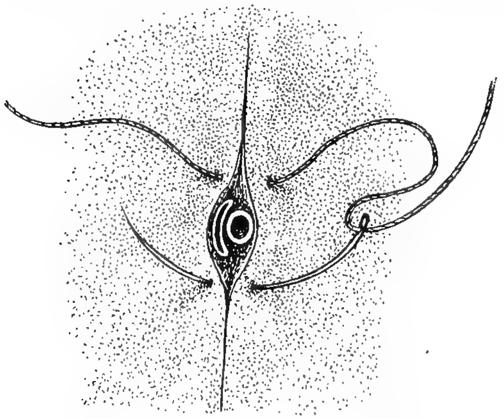

Fig. 256.—Ligation *en masse* or filopressure.

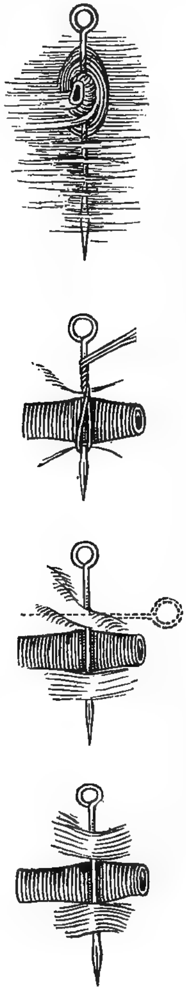

Fig. 257.—Various methods of passing the pin under or over a blood-vessel for the arrest of bleeding by acupressure.

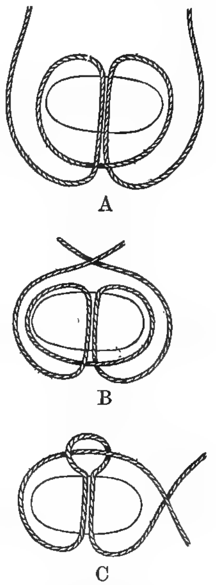

Fig. 258.

A, transfixing a pedicle with a Staffordshire knot; B, the same, ready for tying; C, Bantock's ligature for pedicle.

Staffordshire Knot.—This is used in tying pedicles. The ligature is passed through the pedicle and needle returned so as to leave a loop at the distal end (Fig. 258, A). The loop is then passed over the pedicle and the free ends are brought one above it and the other below and then tied together with a reef knot (Fig. 258). The ligature is in the form of a *clove noose*, which may be used in the absence of a suitable needle (Fig. 259). Bantock's ligature is a very useful method.

Interlocking or Chain Ligatures for Pedicles.—These are useful where much tissue would, if it were included in a simple circular ligature, become loose and slip off from shrinkage due to pressure, as in the case of the spermatic cord, omentum, or the pedicle of an ovarian cyst. The pedicle must be pierced with a handled needle carrying a long ligature having ends of equal length, and the loop of the ligature is held during the withdrawal of the needle until it is unthreaded. The ligature is then divided into two halves, each interlocking one another, so that when one half is tied by a surgeon's knot (Fig. 254, c) the other half is not divided nor any vessel torn asunder (Fig. 260, A). A series of these continuous or interlocking ligatures may be made when necessary (Fig. 260, B and C).

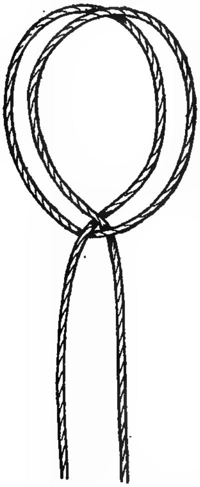

Fig. 259.
Clove noose, or hitch.

Tamponade Plugging.—In large cavities or dead-spaces, where the vessels are not accessible to ligature, plugging the cavity with aseptic gauze, towelling, or some other material is effectual. If possible, the material should be dry. In old veterinary practice tow was commonly used, and although it was effectual in arresting hæmorrhage it generally introduced septic material into the wound, and when removed left behind some fibres to maintain sepsis. If used it should be aseptic and enclosed in a sterile gauze bag. It may be iodoformized or carbolized. For small animals the alembroth ribbon gauze may be used. It should be maintained in position by passing a suture through the cutaneous wound. For the larger animals, in lieu of gauze or tow, a bath-towel boiled for twenty minutes, wrung out and immersed in a 2·5 per cent solution of lysol, and then wrung out again will answer very well.

Styptics—the chemical agents that arrest hæmorrhage when applied to the bleeding surface—should not be used in those parts where there is much areolar tissue, as they are likely to cause much irritation followed by swelling and even gangrene. Solutions of sulphate and perchloride of iron, alum, tannin, resin, carbolic acid, chloride of zinc, and oil of turpentine were formerly generally used, but nowadays they are rarely applied unless for arresting hæmorrhage from the nasal and uterine mucous membranes. They act by contracting the vessels or by coagulating the albumin of the blood and producing thrombi at the mouths of the vessels. They prevent, however, union of wounds by first intention.

Adrenalin chloride applied locally will arrest hæmorrhage from small vessels. Collodion painted on the lips of the wound will act similarly. Compound tincture of benzoin applied on gauze is very useful in arresting hæmorrhage in small cavities. A sponge immersed in boiled water containing 1 per cent of tincture of iodine, or 2·5 of carbolic acid, at a temperature of 120° F. and applied to the cut surface acts not only as a hæmostatic but also as an aseptic. It acts by causing constriction of the blood-vessels and assisting the formation of coagula. Intra-uterine injection of hot water will arrest post-partum hæmorrhage. Although cold will cause constriction of the blood-vessels it retards coagulation. It should not be applied to wounds, as it not only lowers vitality of the tissues but it introduces septic material. Also, in its secondary action or reaction it causes dilatation of the vessels. It is now generally discarded for hot water, which should never be used under a temperature of 110° F. or it will increase the hæmorrhage. In passing, let it be noted that for the successful use of the actual and potential cauteries, styptics, and hot water as hæmostatics, blood clots must be removed and the hæmorrhage checked by pressure before they are applied.

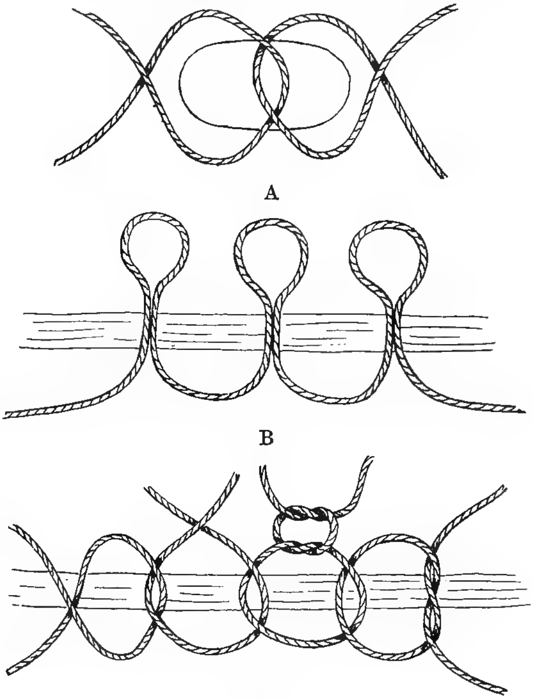

Fig. 260.

A, interlocking ligatures; B, ligatures passed through pedicle; C, chain ligatures for pedicle.

Pressure.—This is very often adopted in arresting hæmorrhage from the lower zones of the limbs and also from a divided palatine artery. A tampon of tow twisted in the form of a firm figure-of-8 applied over the bleeding region and maintained in position by means of a woollen, elastic, or Tetra bandage firmly drawn round the limb several times and then tied will generally check the hæmorrhage (Fig. 261). Sometimes it is advisable to apply a second woollen bandage over the first one. The animal should be kept standing and the bandage removed after twenty-four hours. A similar tampon is applied over a divided palatine artery in the region of the bars and kept in its place by winding a narrow water-dressing bandage several times round the anterior maxillary region above and behind the incisor teeth. Instead of a tampon of tow, lint, or gauze a whole or split wine-cork may be used. For arrest of hæmorrhage from the limbs of the smaller animals a narrow bandage wound round the limb, commencing from the foot upwards in a spiral manner, will generally be successful. Precaution must, however, be taken that the pressure of the bandage is not greater above than below the wound, else the hæmorrhage, instead of being arrested, will flow more freely than if no means were taken to check it.

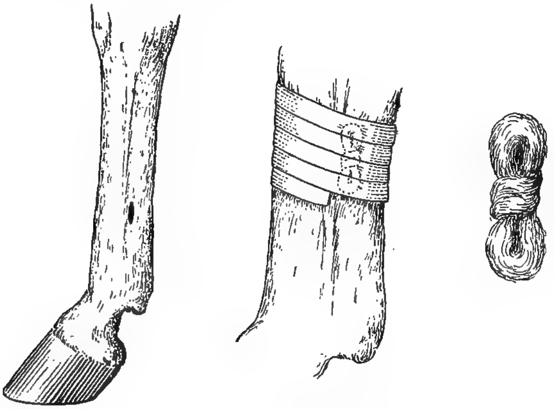

Fig. 261.—Method of arresting bleeding from a vessel in lower part of a limb by a figure-of-8 mass of tow and a yielding bandage.

A graduated compress of several layers of material made up in the form of a cone is sometimes applied over the vessel, and maintained by pressure on the base by a bandage or strapping.

To prevent hæmorrhage supervening under a wound after it has been closed, such as those in the subabdominal region, a thick pad of tow, lint, peat-wool, or cotton-wool should be so applied that when a contentive bandage is fixed and maintained the pressure is evenly distributed over the whole of the wound to obliterate dead-spaces, and prevent sagging and hæmorrhage from lack of sufficient support.

Needles.—The needles used in general surgery are either straight, half-curved, double or treble-curved, or full-curved. The cutting surface may be in the form of a trocar, chisel, lance-head or triangular, with flattened or bevelled cutting borders or a rounded point, like that of the needles used in ordinary millinery (Fig. 262, *a* to *q*).

The transverse section of the shaft of the needle is round, or triangular with the apex of the triangle either on the upper or lower surface of the shaft, oval, elliptical, or flattened from side to side (Fig. 262, *r*). They vary in length from 1 to 6 inches, but they are usually sold in sizes varying from 1 to 18; the smallest being No. 1 and the length gradually increasing as the numbers go up. In some cases, however, this order of numbering is reversed.

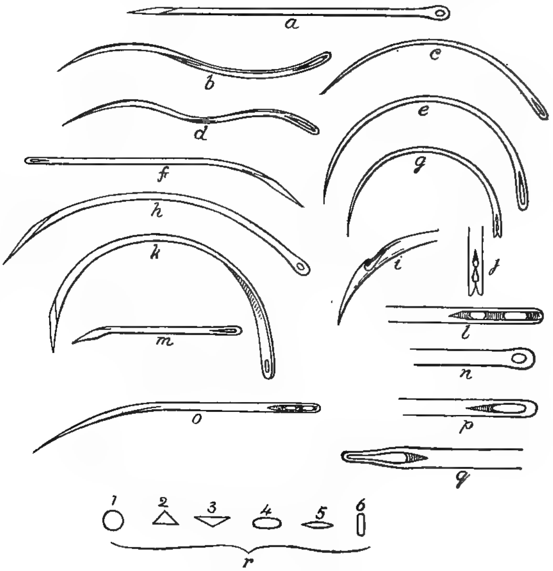

Fig. 262.

a to *q*, needles with various curves, eyes, and points; *r*, 1 to 6. transverse section of various needles.

Hagedorn's needles are flattened from side to side, and in the half-curved and curved shapes are bent on the edge instead of the flat. The point has an oblique cutting edge which readily penetrates or pierces tough skin, like that covering the haunch of the horse, without much force being required. The eye is round, so it is easy to be threaded with the suture material (Fig. 262, *a*, *h*, *n*, and *r* 6). It makes a slit-like opening at right angles to the direction of the wound incision; it does not gape but has a tendency to close up when the suture is tightly drawn up (Fig. 263, *a* 1 and 2 and *b* 2). It does not, however, bear as much strain as the round or transverse puncture, which has, on the other hand, the disadvantage of causing a gaping wound on drawing together the suture (Fig. 263, *a* 3 and 4; *b* 1 and 3). It has the drawback of requiring a suitable needle-holder capable of gripping it at right angles to the holder (Fig. 264, 11).

A needle similar to this, and known as the *reversed* or *modified* Hagedorn, is flattened like the ordinary suture needle from the head to half-way down the shank, whence it gradually takes on the form of the Hagedorn and, like it, has the flattened oblique cutting edge (Fig. 262, *k*). Ferguson's needles are made on a similar principle, only in the case of the curved ones they are more crescentic than semicircular in outline. Doyen's crescentic uterine needles are similar to the modified Hagedorn, only the eye is slit-like instead of being round.

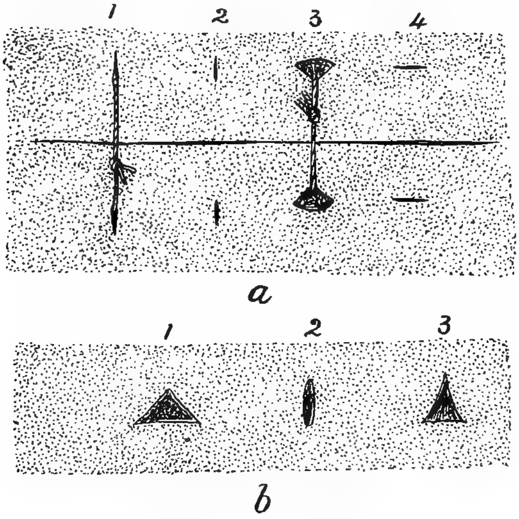

Fig. 263.—Needle punctures.

The calyx-slit or spring-eyed or self-threading needle has the advantage of being easily threaded (Fig. 262, *j*). Paterson's slit-eyed needle has a big eye with a narrow slit running from it to the head (Fig. 262, *q*). The advantage of this is the thread is firmly gripped by the walls of the slit and cannot easily slip out of its grasp.

Those needles generally used in bowel suturing or in suturing divided nerves, blood-vessels, or wounds of serous or mucous membranes have a round shank and point similar to those needles used in millinery or dressmaking. Sometimes for the same purposes a flattened needle with rounded edges is used. They are straight, half-curved, crescentic, or semicircular in outline.

The needles used for carrying leaden composition or pewter wire are tubular at one end, through the lumen of which the wire is passed. Some are provided with an eye so that the end of the wire can be bent over and caught in it so as to prevent it slipping out of the channel (Reek's wire-suture needle) (Fig. 264, 3); and others have a groove so that it is possible to press out the end of the wire should it become broken in the lumen of the tube (Fig. 264, 3). Needles used for carrying silver wire are similar to the ordinary suture needles, but they are provided with deeper lateral grooves running from the eye to the head.

There are many other forms of needle, such as those used in autoplastic operations in the roof of the mouth. Most of them are in the form of a curved hook.

When suturing is carried out in deep, narrow channels, as the mouth or vagina, or in deep spaces, as the inguinal region, it is necessary to use needle-forceps, the length and pattern of which are regulated by the depth in which they are going to be used or the kind of needle they are required to hold.

Needle-holders or Forceps.—Needle-holders or forceps dispense with the necessity of requiring various long-handled needles for suturing wounds in deep and narrow channels and spaces. In lieu of anything better, artery forceps may be used, but unless they have one or two deep transverse or longitudinal grooves in each blade the needle is likely to slip or get displaced when it is firmly opposed to the tissues through which it should pass.

The forceps figured on following page (Fig. 264, 11) are suitable for all kinds of needles, including the Hagedorn; they can also be used as artery forceps. For deep abdominal operations, Doyen's long-handled forceps are very useful, as they hold the needle at any angle (Fig. 264, 7). Macphail's are also very serviceable, as they take all kinds of needles (Fig. 264, 6). They may be obtained in various lengths.

Most operators discard the needle-holder in suturing ordinary operative wounds, preferring their fingers instead; but where strict asepsis or antisepsis is absolutely necessary for the primary union of such divided tissues, as tendon, nerve, and bone, needle forceps can be maintained in a strict state of sterilization whereas the aseptic or antiseptic state of the fingers cannot be guaranteed.

Handled Needles.—Handled needles are not often used in general veterinary practice because, as a rule, of the skilled assistance necessary for their proper use not being available and of their liability to break on any sudden movement on the part of the animal. They are chiefly used in operations on the abdominal walls, in long narrow channels, or in deep narrow spaces.

The handles of such needles are composed of solid steel; their lateral or flat surfaces may be plane or concave, or obliquely or longitudinally grooved. In other instances the handle may be in the form of a loop or ring of wire, sometimes with a thumb-rest (Fig. 264, 8, 9, 10, and 12).

The shanks are straight, long, medium, or short, half-curved or fully-curved, or bent at various angles to suit the purpose for which they are intended, such as intra-oral, intra-laryngeal, or intra-vaginal surgery. In certain instances the shank is straight the greater part of its length, but towards the point it makes a swan's-neck curve, a curve almost at right angles, before making a slight second curve forwards.

The cutting surface may be oblique, pointed, or spear-headed, flattened from side to side, or on the bend. They are either provided with a circular or ovular eye in the centre of the point or with a notch or slot on one of the cutting edges (Fig. 264, 5, 8, 10). In Reverdin's needle (Fig. 264, 5), which is largely used in suturing wounds of the abdominal wall, the slot for the suture material is closed by working a slide (which runs down the centre of the tubular shank) from the handle. This needle may be obtained of various curves (Fig. 264, 5, *a*, *b*, *c*, *d*).

The thumbpieces, provided on some of the wire-looped handles (Fig. 264, 8 and 9) enable the thumb to support the index-finger, which has then more power when the needle is being passed through the tissues before receiving the thread.

Those needles, either curved or straight, provided with an eye a little distance from the point are useful for passing ligature material through a pedicle in order to ligate it and prevent hæmorrhage.

Some practitioners prefer a straight needle because it is more easily introduced through superficial tissues and less likely to be broken. Others prefer the half-curved. The double or treble curved (Fig. 262, *b* and *d*) or undulatory needles are said by those who have used them to be preferable to either the straight or ordinary curved needles because they give a more or less secure grip for the fingers. The full-curved needles are used in those situations where it is not possible to use straight or half-curved ones. For most wounds, however, the writer uses them in preference to the two other forms in nearly every kind of suturing, external as well as internal. As the needles with a handle are fragile they are not economical.

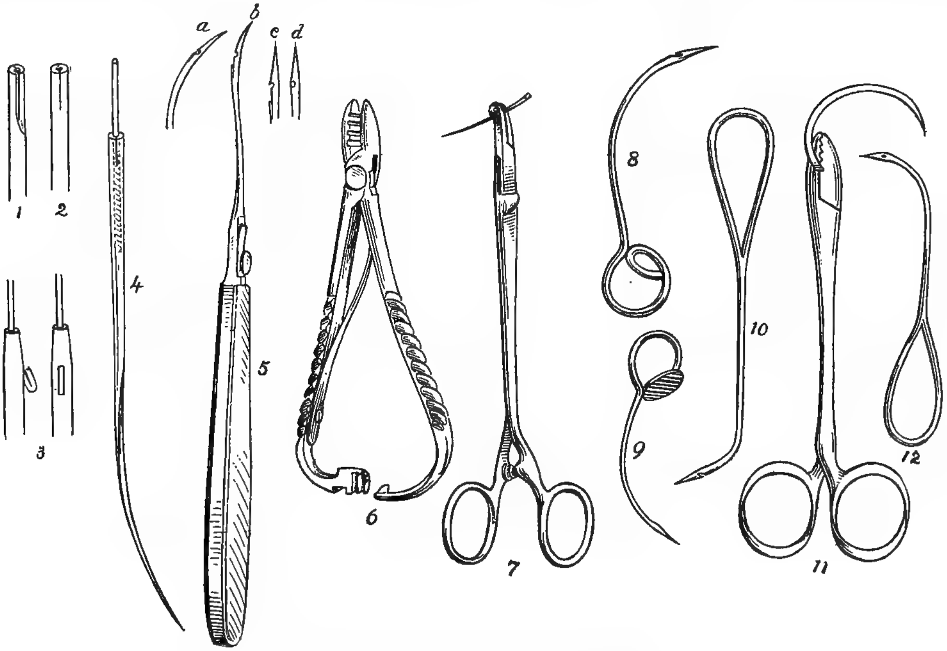

Fig. 264.—Suture needles and needle-holders.

Disinfection and Sterilization of the Hands.—Before Lister introduced his antiseptic treatment of wounds Lefort maintained that the hands were the chief means of conveying infection to wounds, and since that period a great amount of evidence has been brought forward to establish the soundness of that contention. Further investigations have shown how difficult it is to render the hands aseptic, and therefore it behoves the surgeon to take every precaution against introducing infection to wounds made in deep tissues or those in which sepsis would nullify the success of an operation even when it did not destroy his patient. In order to lessen this source of infection, the hands should be well scrubbed with hot water and soap vigorously applied with a stiff brush or a roll of horse-hair. With the object of removing the coarse and hardened epidermis, which usually harbours dirt and quantities of bacteria, after the skin has been softened with soap and water the hardened epidermis should be removed or lessened by rubbing the parts with a tablet of coarse pumice-stone. The nails should be shortened, and the loose epidermis and dirt in the subungual spaces and that covering the matrix should be removed by scraping. After this the hands and even the arms should again be scrubbed with an etherized soap and hot water, rinsed in a 2·5 per cent solution of lysol, and allowed to dry. Painting the hands all over with tincture of iodine and allowing it to dry into the skin appears to have a sterilizing effect on them.

In the event of the practitioner having to assist in casting and fixing his patient after sterilizing his hands, he should wear wash-leather gloves while so employed and again sterilize his hands before commencing the operation. Should he have occasion to place his hands in contact with any part of the body or any object that has not been sterilized during the operation, he should take the precaution of washing them in a 2·5 per cent of lysol before they again come in contact with the wound.

When much manipulation is required in the peritoneal cavity the operator may wear thin india-rubber gloves or gauntlets which have previously been sterilized in some reliable disinfectant as an extra precaution against the introduction of infection. The objection to rubber gloves is that they interfere with tactile sensibility, but with use this may be overcome.

The operator should wear a smock with sleeves turned up, or when it is a case in which the whole arm has to be deeply introduced into the peritoneal cavity, rectum, or vagina, a sleeveless one is preferable. The smock may be made of thin mackintosh, holland, or twill.

Sterilization of Instruments.—Instruments like the hands, unless previously sterilized, are likely to introduce infection into a wound, and it is imperative that they should be disinfected. It is now generally agreed that the simplest and most effectual way to sterilize them is by boiling them in water for twenty to thirty minutes. It is better to place them in the sterilizing utensil whilst the water is at boiling-point. Tap- or well-water, in consequence of the mineral impurities it contains, produces on instruments during boiling deposits which discolour and, to a certain extent, injure them. To obviate this, sodium carbonate or biborate to the extent of 1 per cent, which raises the boiling-point, is added to the water. In my experience, however, soft or hard soap, or lysol, is preferable as it is a better detergent, and instruments left in such a solution, provided they are covered with the fluid, neither tarnish nor undergo any injurious effect. Jointed and serrated instruments should have their crevices well brushed with soap and water to remove any debris remaining in them at the time of boiling.

Many appliances have been devised for boiling instruments, but the elongated enamelled sterilizer with a perforated enamelled iron lift-out tray or a wire sieve is as effectual as and much more economical than the more expensive ones made of heavy copper, tinned inside and nickelled outside. It may be heated by gas, electricity, paraffin, methylated spirit, petrol, or by being placed on a coal, coke, or wood fire.

A saucepan, fish-kettle, pail, or even a deep tin canister or biscuit box in lieu of anything better is sufficient to obtain an effective sterilization by maintaining instruments at a temperature of 212° F. for twenty minutes. In an uncovered utensil the boiling-point is not obtained throughout the whole bulk of the water, therefore a utensil with a lid is to be preferred to an uncovered one.

Smooth, nickel-plated instruments may be sterilized by immersion in pure carbolic acid for twenty minutes, and then washed in methylated spirit. Lysol may be used instead of carbolic acid. Placing instruments in an ordinary oven for an hour in a temperature from 150° C. to 165° is an effective way of sterilizing them by dry heat, but it has the drawback of rendering them liable to injury.

When instruments have been sterilized they should be placed in a 5 per cent solution of lysol before an operation, and when used they should be transferred to a 2·5 per cent solution of the same agent or, if preferred, carbolic acid of the same strength.

Sterilization of Sponges.—As sponges when purchased contain grit and calcareous particles they should be beaten with a flat stick until as much grit as possible is removed from them. They should then be squeezed out repeatedly in warm water and then immersed in 20 per cent of sulphurous acid, peroxide of hydrogen, or dilute hydrochloric acid. The last agent dissolves all the remaining cretaceous material in the tissue of the sponge.

They may be sterilized by placing them in cold water and gradually raising it to boiling-point, when the vessel containing them should be removed from the fire, as continuous boiling destroys their texture. They may also be cleansed by thoroughly washing them in a hot solution of carbolic acid with soap, rinsing in sterilized water, and then placing them in 1 in 20 solution of carbolic acid for at least twenty-four hours, when they should be squeezed out and placed in a 2·5 per cent solution of carbolic acid ready for use.

If preferred, sterilized gauze, lint, bath towelling may be used, or cotton-wool immersed in 1 in 20 carbolic acid solution for an hour, squeezed out and then placed in 1 in 40 carbolic solution, 1 in 2000 sublimate, or 1 in 4000 biniodide solution, and wrung out before applying to the wound.

Preparation for Operation.—In all important operations in which urgency is not necessary the practitioner should inform his client of his conclusions, obtain his consent, and give instructions for the animal to be prepared. In many cases where time is not allowed, as in strangulated hernia, prolapse of the uterus, bladder, or rectum, compound fractures, accidental wounds, etc., preliminary preparation is out of the question. But in the castration of cryptorchids and females and, in fact, any operation necessitating the use of general anæsthesia the animal should be prepared by fasting, physic, or enemata, according to circumstances. Weakly or badly-nourished animals, or those that are suffering from some debilitating disease, require to be well fed with nutritious, stimulating, and tonic diet. Old and fat animals, which are usually anæmic, should not be fasted more than twenty-four hours, and strong aperients should not be given. Strong, plethoric, and vigorous animals are benefited by fasting and an aperient. Animals that have been well fed and moderately worked can withstand a greater loss of blood than aged, debilitated, fat, or soft horses. Again, they are less liable to shock, which may occur even without the loss of much blood.

There is less hæmorrhage during or after an operation on an animal properly prepared by dieting, fasting, and abstention from water for at least twenty-four hours prior to the operation. And bacteriological examination of the blood has shown that it contains fewer bacteria after fasting than after a meal. Much of the success in castration and spaying by the older practitioners and gelders was attributed to this practice.

In the carnivora an empty stomach is essential, in order to prevent vomition taking place immediately after recovering from the effects of the anæsthetic. This is more likely to take place in the cat than in the dog.

The seat of operation should be freed of hair by clipping, and if thought necessary by shaving, after the part has been well lathered with an ethereal or spirituous solution of soft soap. This latter procedure is not, in my opinion, necessary; nor is washing with a 2·5 per cent solution of lysol unless the part is very dirty. The skin may be disinfected with a spirituous, petrolized, or etherized solution of iodine, which is allowed to dry into the skin sometime before making an incision.

If the region is infected, ulcerated, or fistulous, or the seat of a suppurating wound, scraping the part with a curette and disinfecting it a few days or the evening before the day of operation should be carried out. In operations on the natural channels the mucous membrane should be washed with a warm sterile solution of bicarbonate of soda in order to remove secretions, and afterwards irrigated with a 1 to 2 per mille solution of permanganate of potassium or ·5 per cent of lysol. In the case of the mouth, loosened teeth should be removed, and when pyorrhœa is present the gums, alveolar processes, and cavities painted with tincture of iodine or 2 per cent of zinc chloride.

In operations on the bowel it is difficult to assure intestinal antisepsis, but the administration of aperients, salines, mashes, and a milk diet is advantageous when carried out a few days prior to the operation. Such treatment not only reduces *intra-abdominal pressure* and distension of the viscera but also reduces excitability, resistance, the liability to hæmorrhage, prolapse, hernia, rupture, and inflammatory reaction. In surgical interference with the rectum, irrigation of the bowel with 1 in 500 to 1000 solution of permanganate of potassium reduces the chances of infection.

The surface of the eye and conjunctival sac may be rendered fairly sterile by irrigation with a warm 4 to 8 per cent solution of boric acid, 1 in 1000 of permanganate of potassium or of chinosol, or 1 in 4000 of biniodide or perchloride of mercury. In the event of the conjunctival membrane or the cornea being affected with suppuration a 1 in 500 solution of nitrate of silver is the most effectual disinfectant.

In operative interference with a bladder affected with cystitis due to calculi, antisepsis may be carried out by the administration of hexamine, sodium biborate, or sodium salicylate, a purely milk diet and sedatives, such as henbane. The injection of antiseptics directly into the bladder serves no useful purpose, but is likely to do harm.

In foot cases the shoe should be removed, the hair clipped from the fetlock downwards, and the hoof pared to remove loose and dirty horn. The skin and hoof should then be scrubbed with hot water and soft soap, and afterwards immersed in a hot solution of lysol for half an hour, and finally enveloped in antiseptic compresses enclosed in mackintosh and covered with a bandage.

Excision

Excision denotes the removal of a diseased or abnormal part by division of the healthy tissue circumscribing the diseased or abnormal. It is also used to denote removal of a healthy organ, as the ovary or testicle, or a portion of healthy tissue or structure, as a piece of nerve or tendon. When a portion of bone, nerve, bowel, tendon or any other anatomical part in continuity is excised the term *resection* is often applied to the operation.

The method of excision varies according to the attachments of the diseased tissue or tumour.

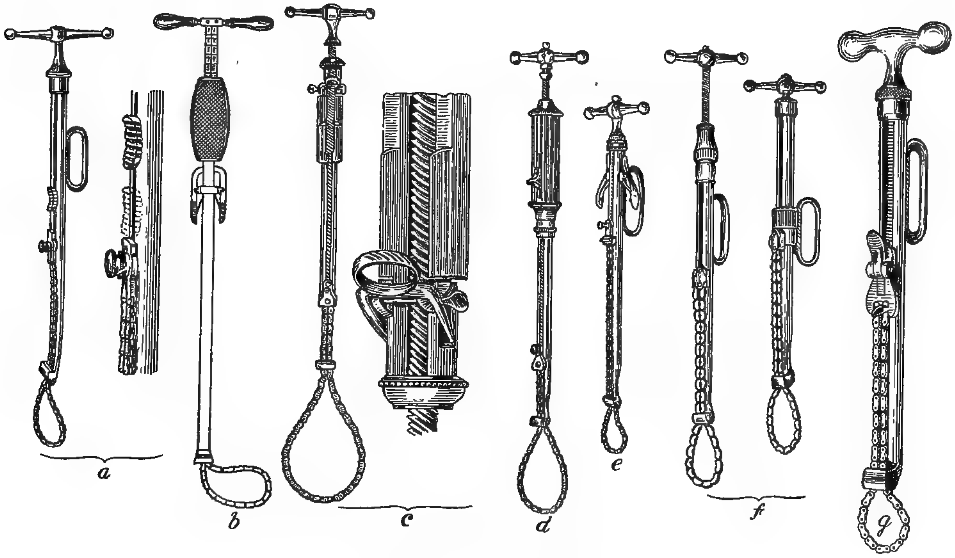

Fig. 265.—Écraseurs.

a, Dewar's pattern; *b*, improved Chassaignac; *c*, *d*, *e*, *f*, and *g*, American patterns.

In the case of pedunculated tumours or organs, as the ovary, testicle, or penis, there are no blood-vessels of importance except those in the pedicle or above the line of excision. A polypoid mass in one of the natural channels may be twisted or pulled from its base with a pair of strong forceps. The testicle may be removed by tearing, scraping, traction, torsion, ligature, actual cautery, écraseur, emasculator, or castrator, caustic clams, rubber ring or ligature, or in the case of the young of the smaller animals by simple excision. The ovary in the mare and cow is removed by the vaginal route with a long-shanked écraseur (Fig. 265). When tumours are very vascular and are not removed with the clamp or écraseur, the pedicle should be sought and ligatured before the tumour is excised.

As cystic and solid tumours are separated from healthy tissue by a capsule of inflammatory tissue they may be removed by dissection. Some cysts, newly formed and retention cysts, have a very thin capsule, so great care is required not to cut into their envelope in dissecting them out. Should accidental puncture take place the capsule should be seized with a strong pair of forceps, pulled out and given a few twists, when the whole of it will come away.

In the removal of tumours or diseased glands from the parotido-pharyngeal region, the course of the jugular furrow, the axilla or groin, in order to lessen the risk of dividing important structures, as nerves or large blood-vessels, or to prevent profuse hæmorrhage, *blunt dissection* with some dull-cutting or blunt instrument is often adopted. The blades of a closed pair of scissors, a spatula, the back of a scalpel, a director or some specially devised instrument termed a blunt dissector or enucleator (Fig. 266, *b*, *c*, and *e*) may be used for this purpose. Where the surrounding connective tissue is plentiful and lax, tearing with the fingers, pulling and twisting at the same time may be resorted to, as in the case of some of the freely movable tumours on the under surface of the abdomen of the dog. There is very little hæmorrhage from this procedure, and provided the operation is carried out aseptically or antiseptically the resulting wound repairs almost as quick as one made by sharp division. Such wounds having many little pockets on their surface and the damage of the tissues being greater, suppuration and necrosis may be severe where strict cleanliness is not observed.

In dealing with infiltrating tumours, such as the carcinomata, and sarcomata, and some forms of inflammation where there is no well-marked line of demarcation between the healthy and diseased tissues, it is necessary to include in the excisions healthy tissues well beyond the line, in order to make the removal of the diseased structures as complete as possible.

Too much traction should not be made on the part to be excised in order to prevent tearing or breaking away and thus leaving behind some of the diseased tissue. A bold sweeping incision should be made without penetrating large vessels or other organs.

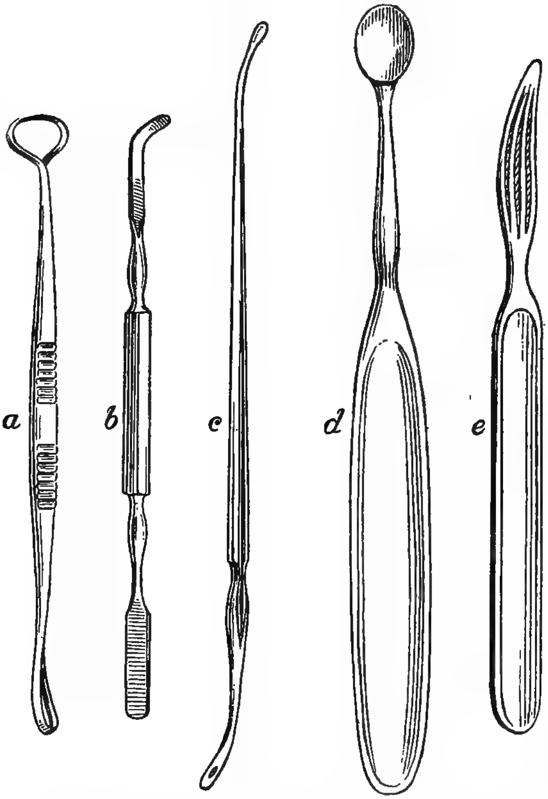

Fig. 266.

a, double-ended curette; *b*, blunt dissector; *c*, combined probe, director, aneurism needle, and blunt dissector; *d*, curette (Volkmann's); *e*, Kocher's blunt dissector and gland enucleator.

For the excision of small warts, those small melano-fibromata embedded in the depth of the skin, and small granulomata on the skin of the dog, the skin should be gripped below the tumour between the thumb and finger of the left hand while a pair of dull-cutting, curved clipping scissors held with the right hand cuts off close to the skin or squeezes out of its bed the new growth or inflammatory enlargement, leaving a clean raw surface which should be cauterized before releasing the skin. By this method, which is carried out most expeditiously, such growths are removed bloodlessly and the wounds do not require subsequent treatment.

For the resection or excision of nerve, the ends of a fracture forming a false joint or excision of an epiphysis, the parts are exposed and divided so as to form a breach in continuity, which may, if necessary, as in the case of bone, tendon, or bowel, be brought into continuity again by suturing, etc.

Tearing and *twisting*, by means of the fingers or of a pair of strong forceps, are useful procedures as they are followed by little if any hæmorrhage. In the case of well-defined subcutaneous tumours after the skin has been divided and dissected from the upper surface of the new growth, they may be removed by tearing them from the surrounding loose areolar tissue. The advantage of this method is that should the new growth be malignant, it is less likely to leave any of the infective material behind to start a fresh growth elsewhere.

Elastic Ligature.—Rubber or elastic cord passed round a peduncular tumour and tied firmly acts by continuous pressure arresting the circulation in the tumour, which undergoes necrosis and eventually falls off. In certain tumours with a rather wide sessile base, long needles or skewers may be passed through the base and the ligature tied above them in order to prevent it slipping. Rubber rings may be used for the same purpose. The elastic ligature has been extensively used in the castration of fat lambs two or three months old. It has also been used for removal of the prolapsed uterus. Other methods are more humane and give speedier and safer results.

Clams or Clamps.—These are made of steel, aluminium, or wood, and are used for similar purposes to those of the elastic ligature. Excepting their use in the treatment of hernia, in preventing hæmorrhage during the cauterization of pedunculated tumours and in the removal of the testicle, their employment, especially the caustic clams, is unjustifiable in consequence of the suffering they cause. This method, also termed *Angiotripsy*, includes crushing the vessels as well as the other tissues that are included between the blades of the instrument.

The écraseur is a useful instrument for removing organs and morbid growths having a pedicle—as the testicle, scirrhous cord, polypi, etc.

The prevention of hæmorrhage is best obtained from an instrument provided with a wide chain having a bevelled or smooth inner cutting or crushing edge, and slowly drawn up into the barrel in the stem. If a sharp chain is employed and too rapidly tightened, hæmorrhage from the divided tissue is more likely to occur.

There are two kinds of écraseur: one, the Chassaignac (Fig. 265, *b*), which draws the chain up into the flattened channel in the stem of the instrument by working the handle from side to side; and the other which draws the chain up by turning the handle round and round until that portion of the organ or tissue to be removed is divided. Such are those of Miles (Fig. 265, *e*), Reynders (*d*), Haussmann (*g*), Sharp and Smith (*f*), many American inventors, and also Dewar's (*a*). They should be provided with a female screw or releasing attachment which when relaxed enables the operator to draw up the chain so as to fix the tissues between the chain and the nose-piece of the stem of the instrument without any tedious movements of the handle. Both the Chassaignac and those revolving on a screw are now provided with this improvement, thanks to the ingenuity of the American inventors.

Besides a chain, wire, or string, hard cord may be used for dividing the tissues. For vaginal oöphorectomy in the mare an écraseur with a longer stem is necessary. Cadiot's pattern is an elongated Chassaignac.

With the same object in view, that of dividing a pedunculated organ without hæmorrhage, various patterns of an instrument termed an emasculator have been introduced for the castration of the larger animals. They are chiefly used in the standing operation. The best of this class is Haussmann and Dunn's safety emasculator. Emasculators prevent hæmorrhage by crushing or sawing the tissues and dividing the middle and inner coats of vessels which curl up in the lumen before the outer coat is crushed through. They do not destroy the vitality of the wounded end of the stump, which undergoes a superficial necrobiosing process and heals almost as rapidly as a wound made with a scalpel.

Scraping, or Curetting.—Scraping, or curetting, is adopted for the quick removal of dead or diseased tissue, which might otherwise take some time to separate, and during that time infect the surrounding healthy tissues. It is also carried out with the object of removing or exposing infection infiltrating the tissues, so that powerful antiseptics or mild caustics may come in contact with and destroy the micro-organisms.

Scraping is performed with a Volkmann's sharp spoon (Fig. 266, *d*) or a curette (Fig. 266, *a*) until all the diseased tissue is removed and the healthy tissue exposed. During the scraping process the part should be irrigated or flushed with water from time to time. Any tough tissue that cannot be removed with the curette should be excised with the knife or scissors, or in the case of bone or cartilage with a gouge.

There are various patterns of sharp spoon and curette, some of the latter being made with irrigation attachments so that flushing goes on during the scraping, washing away the debris formed by the broken-down tissue.

In treating sinuses, as much of the tough wall should be removed with the knife as is possible and the rest scraped. In the case of sinuses in the region of the hoof, as much of the diseased wall should be destroyed with the actual cautery and then removed with the curette.

When being carried out on a thin-walled cavity, as the uterus, or in a large abscess cavity with a very vascular wall, or in contact with large vessels or with a wall of friable tissue, the scraping must be gently carried out in order to obviate perforation.

Where the scraped surface is small in area pure carbolic acid may be applied to it, or it may be gently rubbed with nitrate of silver. If the surface is extensive, a strong solution of sulphate of copper or zinc, or a fairly strong one of zinc chloride may be employed, taking care immediately to wash away the fluid.

In the great majority of cases of necrosis of bone I prefer natural exfoliation to curettage, as the living tissues soon loosen the necrotic tissue, which can then be removed with a strong pair of forceps, leaving behind it a healthy granular surface. In human surgery, into which tubercular or syphilitic disease of bone enters largely, curettage is extensively employed.

Punctures

Puncture denotes a more or less deep wound made in a tissue, tissues, or a hollow organ by means of some sharp narrow instrument. The depth of the wound so made is very much greater than its width.

Puncture is made with a narrow bladed lancet or knife such as Paget's or Syme's, as in opening an abscess or cystic cavity; with a grooved needle or fine trocar and cannula, as in cases of exploratory puncture, hydrothorax, ascites, for allowing the escape of an effusion from the thorax or abdomen, urine from the bladder in case of retention from obstruction of the urethra, gas from the stomach or intestine in tympany; with hollow needle for the introduction of a fluid medicament, serum, or vaccine from a syringe or a hydrostatic reservoir.

For puncturing the chest between two ribs (paracentesis thoracis) a trocar and cannula (Fig. 267, *b*) of 3 to 4½ inches in length, about ⅛ in. in diameter, and provided with a round or oval handle, is required for the horse, the shorter length being suitable for light-bred horses and the longer for heavy, thick-chested cart horses. Before inserting the instrument, which should be sharp, the skin should be clipped and disinfected and drawn to one side, so that after the operation the skin glides back into its normal position and covers the subcutaneous wound.

For small animals the writer prefers an incision through the chest wall to a puncture made by trocar and cannula. Some operators incise the skin previous to passing the trocar and cannula through the chest wall.

Should no fluid pass through the cannula after the trocar has been withdrawn, the cannula should be directed forwards or backwards, upwards or downwards, so as to break down any adhesion or to remove the orifice of the cannula from the surface of the opposing lung.

In ascites a shorter but a larger gauged trocar and cannula is preferable to the smaller gauged instrument used for pleural effusion. For the cat and dog, laparotomy is preferable to the trocar and cannula.

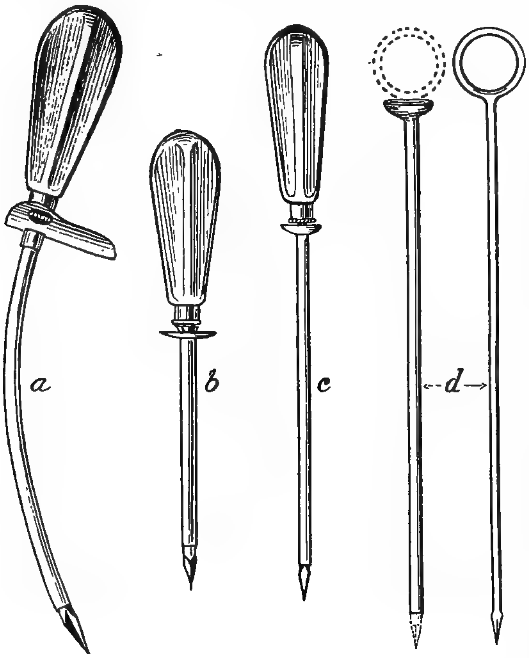

Fig. 267.

a, curved trocar and cannula for tympany of bowel and puncture of bladder through rectum; *b*, trocar and cannula for tapping the chest; *c*, trocar and cannula for intestinal tympany; *d*, exploring cannula and trocar.

For exploring purposes a hollow grooved needle, hypodermic needle, or fine trocar and cannula (Fig. 267, *d*) pushed into the depths of a circumscribed or diffused swelling, or into a cavity suspected to contain pus, serum, chyle, or blood, enables one to make a positive diagnosis.

A very useful instrument for puncturing an abscess, cyst, or closed cavity for either diagnostic purposes or the evacuation of fluid contents is one made on the plan of a lady's curling tongs, in which one round or convex blade fits into the concave or channelled blade of the other. The point of the convex blade is sharp and carried some little distance beyond the point of the other. The blades should embrace each other so that when closed they form a smooth cylinder with a sharp conical point. There may be an orifice near the point and another near the joint, fixing both blades together like a pair of scissors, so as to allow fluid to flow into, through, and out of the channel. After this instrument has been plunged into a cavity and no fluid escapes, the blades may be opened so as to act as a dilator.

The trocar and cannula used for relieving tympany of the rumen in the ox are usually round, having a diameter of about $\frac{1}{2}$ in. to $\frac{3}{4}$ in. and a length of 8 to 12 inches, not including in this the handle. Some practitioners prefer a flattened oval trocar and cannula. Those used for relieving the horse of intestinal tympany are about 12 inches long, $\frac{1}{8}$ to $\frac{3}{16}$ in. in diameter, and either curved or straight (Fig. 267, *a* and *c*). For the introduction of fluids into the cavity of the viscus a cannula with the channel extending above the shield is necessary to attach a piece of rubber tubing which is connected at the other end with a reservoir, funnel, or syringe, such as a Higginson, for the reception or introduction of the fluid. Similar means are adopted for lavage or washing out the pleural cavity, and by lowering the rubber tubing below the recipient the chest will empty itself by siphonage, which is very much less tedious than by withdrawing the fluid by means of an aspirator.

Some of the cannulæ used in paracentesis thoracis are provided with a short tube standing out at a right angle from the long tube, or have an oblique tube near the shield or a stopcock as in Potain's aspirating trocar and cannula.

A curved trocar and cannula is used for puncturing an over-distended bladder through the rectum (Fig. 267, *a*). By using a straight instrument this viscus may be punctured through the abdominal wall. Abscesses or cysts, and distended bursæ may be evacuated by means of a trocar and cannula, and through the wound made by the instrument drainage tubing or a seton may be introduced.

Cannulæ that are required to be maintained in a cavity for some time are provided with a shield having perforations for the attachment of tapes to keep the instrument in its proper position.

When the cannula is being withdrawn the skin surrounding it should be pressed back to the underlying tissues so as to avoid producing a pocket for the collection of fluid. The wound should be disinfected with tincture of iodine.

Puncture is sometimes made with a pointed cylinder or sharp red-hot iron, as in cauterization by points or in perforating abscesses, cysts, and other cavities. Multiple punctures with a fine knife or lancet or scarificator are occasionally made with the object of reducing the volume of an œdematous part, as the sheath, or as a counter-irritant.

Puncture with a sharp needle (acupuncture) is made between the ends of a disunited fracture so as to break down a lowly organized tissue and to induce reparation; also in cases of periostitis to relieve tension, as in the early stage of splint; and in spavin and other bone diseases.

Aspiration

Aspiration is the evacuation of the fluid contents of a closed cavity by suction. The commonest form of aspirator is that of Dieulafoy, a syringe-like apparatus having two short nozzles fitted with stopcocks. To one of these is fitted an india-rubber tube, at the end of which is a sharp hollow needle with an opening at the point. To the other nozzle is fitted a long rubber tube to carry away the aspirated fluid, or when both stopcocks are turned on, as a siphon. In using the instrument it should be previously sterilized or disinfected, and then both stopcocks closed. The piston of the exhausting syringe should be drawn up and maintained in position by a quarter twist of the handle. The needle is pressed into the cavity to be evacuated and then the stopcock connected with it is turned on. The vacuum produced causes the fluid to flow into the vessel, which, when it is filled, is emptied after the stopcock connected with the needle is turned off, and the other stopcock is turned on and the plunger pressed down. This aspirator may be used for injection of solutions into cavities after they have been freed from their contents.

Potain's aspirator acts in a similar manner to Dieulafoy's, but instead of the aspirated fluid being drawn into the exhaust syringe it is sucked into a bottle fitted with a rubber plug, through the centre of which passes a tube formed by the blending of two tubes, each of which is provided with a stopcock. Instead of an aspirating needle one of the rubber tubes is armed with a special trocar and cannula provided with a stopcock and a side channelled slot, into which the rubber fits by a metal mount. It is advisable to have a break in the rubber tubing so that the ends may provide a position for the reception of a glass tube in order that the operator may be able to observe if any fluid is flowing from the cavity, and its nature.

For the aspiration of urine containing sabulous material or granular particles or fragments of calculi from the bladder, Thompson's or Bigelow's evacuator may be used. But any rubber bulb syringe provided with a stopcock at its neck and inserted into the orifice in the head of a fairly large-sized gum elastic catheter with a wide opening on the surface a little distance from the apex, may do equally well in sucking out the granular material along with the urine or fluid that has been injected. Such an instrument inserted into the head of an aspirating or hollow needle may be used for evacuating fluid from cysts or bursal distensions.

For diagnostic purposes or for small cysts an ordinary hypodermic or antitoxin syringe fixed to a fairly long needle is quite useful. It is sometimes employed for the withdrawal of serous fluid from bog-spavin, thoropin, cystic elbow, and for the injection of iodine solution into the emptied cavity. This must be performed under strict antiseptic or aseptic precautions. Aspiration is rarely used as a means of removing exudates or effusions from the chest or abdomen. In man it is sometimes employed with drainage after thoracocentesis to promote expansion of the lung and obliteration of the empyemic cavity. For this purpose Bryant uses a special apparatus consisting of a hollow rubber cushion in the form of a shallow cup through the centre of which passes the rubber tube which is inserted into the chest and connected with a ball syringe. The tube above the cushion is provided with a stopcock and a small portion of glass tubing.

Should the needle or cannula become blocked with pus, clots of fibrin, or other thick material it should be cleared with a fine stylet, probe, or other obtuse instrument passed through the whole length of the channel.

Aspiration of the anterior chamber of the eye may be carried out by means of a hypodermic syringe and needle. For the removal of broken-down soft lens a special suction syringe is generally used.

Incisions

Incisions are made with the object of dividing tissues for the purpose of laying out to the view of the operator the underlying structures which may require excising or removing, approximating or replacing in their normal position; or for the removal of foreign bodies, such as calculi, bullets, or fragments of loose bone. They are also made into the outer wall of an abscess or cystic cavity for the evacuation of its fluid contents.

They should be well planned so as to cause as little mutilation as possible, and at the same time to give the operator sufficient space to do his work with little difficulty, as in arresting hæmorrhage.

Incisions are made by cutting from without downwards, from within outwards, or subcutaneously.

They should be made with a scalpel, preferably one with a fused or fixed handle, which should be of smooth metal. There should be no constriction or neck between blade and handle.

The latter may be quite plain, or have a concavity, longitudinal or transverse grooves on the flat surfaces; or be in the form of a wire loop (Fig. 268, *d*) with the object of giving the fingers a better grip, and thus when wet with blood or antiseptic fluid prevent slipping (Fig. 268, *a*, *b*, *c*, *d*, *e*). The back of the blade should be straight and fairly thick until it reaches a short distance from the point, when it should gradually slope until it meets the thin cutting edge.

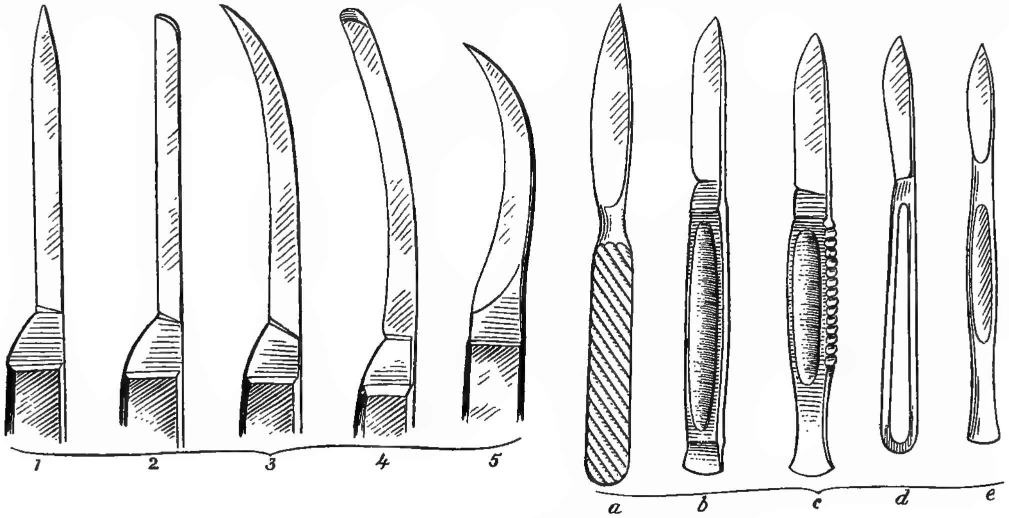

Fig. 268.—Bistouries and scalpels for incisions.

1, 2, 3, and 4, bistouries; 5, Syme's abscess knife; *a*, *b*, *c*, *d*, and *e*, scalpels.

For a very small incision a small, narrow-bladed knife is best. For incising the coverings of the testis in castration and the abdominal wall in spaying, most practitioners prefer a short-bladed knife with a straight back and a short curved cutting edge. The handle rests in the palm of the hand and the blade is so gripped that only one-third or at most half of the blade is left uncovered (Fig. 269).

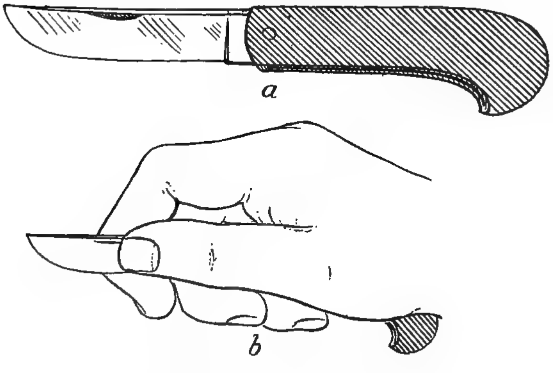

Fig. 269.

a, castration knife; *b*, method of grasping it.

The ordinary scalpel is generally held in three ways: first like a pen (Fig. 270, *a*), second like a dinner knife (Fig. 270, *b*), and third like a violin bow (Fig. 270, *c*).

The first position is that usually adopted in dissection of the cadaver, but it, like the turning of the sharp edge from the depth of a wound and cutting upwards and outwards to the skin, should not be used in operative surgery. In making an incision downwards, as in castration, cutting down on a tumour or on to an artery in continuity, the skin should be made tense and the knife held perpendicularly so as to penetrate the subcutaneous and even fatty tissue; the handle should then be lowered and the incision extended by drawing the convex part of the cutting edge steadily along. Unless the tissues are very tough, a sawing action should be studiously avoided. Another method of preventing the skin slipping while an incision is being made is for an assistant to roll up a fold of skin and hold it in a state of tension between the thumb and index finger of each hand, the incision being made between the two. Or the operator may use the index finger and thumb of his left hand as stretcher and pressor while he makes the incision from between the thumb and finger with his right hand.

It is bad practice to have the superficial incision longer than that in the deeper parts of the wound. The incision should be the same length the whole depth of the wound. As the incision is being made deeper the structures forming the more superficial parts of the lips should be held apart by means of special forceps or a ligature passed through each lip and tied in the form of a loop, by retractors, or by forceps with serrated or toothed points, to prevent the tissues slipping from their grasp (Fig. 271, *a* and *b*).

In making incisions in the more superficial operations, as in plantar neurectomy, thumb or spring forceps (Fig. 272) with serrated or claw-bite jaws, commonly termed mouse- or rat-tooth forceps, are very useful to hold fascia which is to be removed or incised near the point grasped. The scalpel should be held nearly at right angles to the forceps when the incision is made, especially when important structures, as blood-vessels or nerve, lie immediately beneath the line of incision. Such forceps are also very useful to hold the lip of the wound when the suture needle is being passed through it.

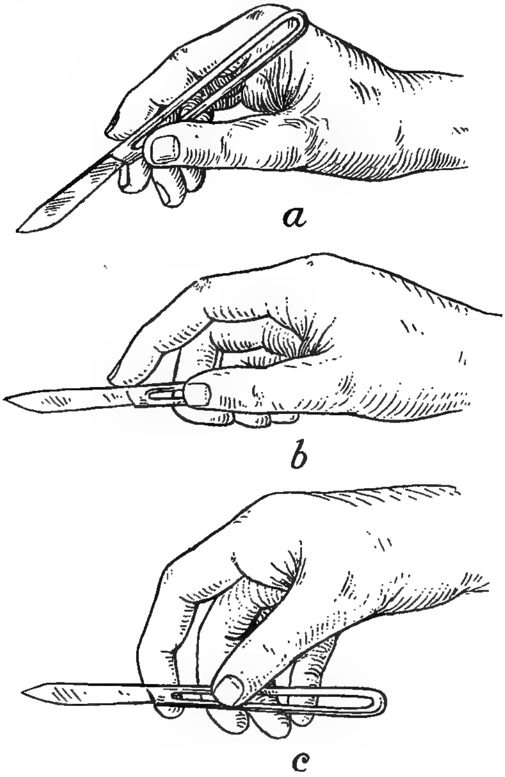

Fig. 270.—Three methods of holding a scalpel.

In the division of deep fascia over important structures which should not be wounded, it may be necessary to catch up and lift with a pair of toothed forceps (Fig. 271) a piece of the tissue and make a small hole through it for the passage of a grooved director (Fig. 274), and to carry the back of the knife which is gently pushed along the groove while the sharp edge is dividing the tissue. Some surgeons discard the director and hold the fascia in tension between two pairs of toothed forceps while cutting it between them. Where the tissues are very loose under the fascia a probe-pointed bistoury (Fig. 268, 2 and 4) guided by the forefinger of the left hand on the point may be used instead of a director. The blunt- or probe-pointed bistoury (Fig. 268, 2 and 4) is a useful instrument for the incision of fistulæ or sinuses from within outwards, and so is the sharp-pointed straight or curved bladed bistoury, but the latter should be used in conjunction with a director (Fig. 274, *a*) or grooved sound which is passed down the course of the sinus so that the back of the knife can glide down the groove and thus avoid injury to structures lying behind the deep wall of the cavity (Fig. 273).

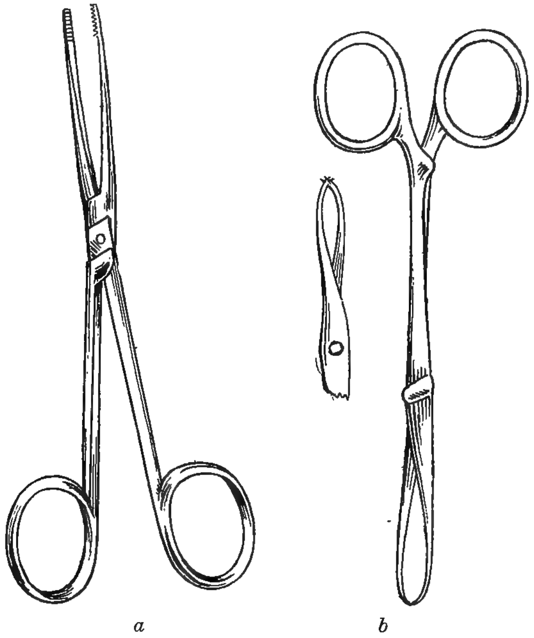

Fig. 271.
a, Lister's sinus forceps. *b*, Flap forceps or extractor.

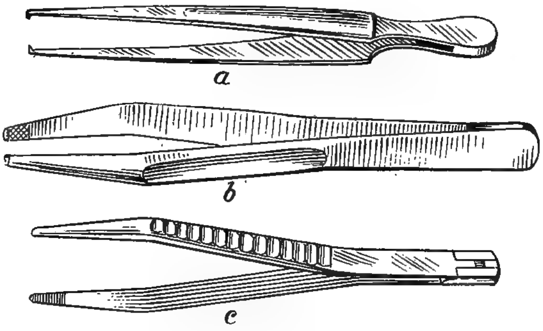

Fig. 272.—Spring forceps (various).

a, with one tooth at the point of one blade and two at the point of the other; *b*, two- and three-toothed blades; *c*, with transverse lines inside the points.

Incisions may be made with scissors (Fig. 275). Small incisions for the passage of setons through the tough skin of the horse or ox may be made with a rowelling bistoury, while a fold of skin is held between thumb and index finger of the left hand.

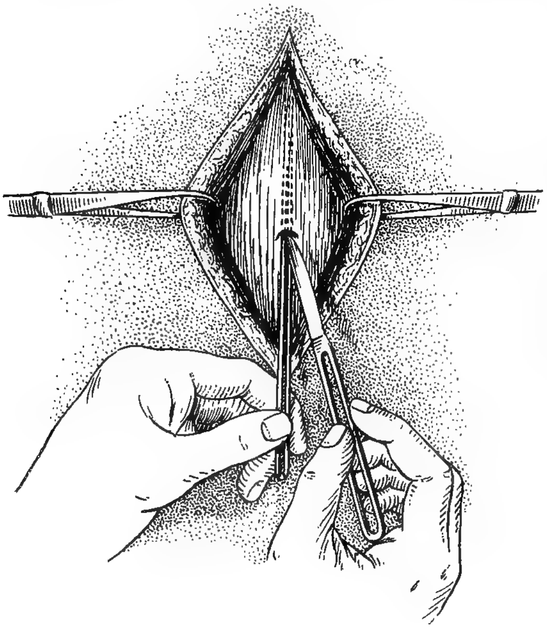

Fig. 273.

Scissors, especially those with rounded, blunt points, are useful in incising the outer wall of a sinus or cavity, and lengthening incisions already made with the knife, especially those through the muscular and serous walls of the abdominal cavity. For this latter purpose they must be very strong and powerful.

The direction of incisions varies. The linear or straight incision is most in use; it should never be made transversely to the course of important structures such as vessels, nerves, tendons, muscles unless circumstances necessitate it. On the other hand, it should be in a direction favourable to natural drainage in case of need. When made to expose deeper parts the lips of the wound thus formed are held apart by retractors, forceps, or dilators.

The T, inverted ⊥, L, V, and crucial ✚ incisions are useful as preliminaries in the formation of angular flaps, which when reflected enable the operator to see the exposed, underlying parts, and to carry out further surgical interference, as in the removal of tumours, excision of bone as by trephining, etc. These incisions are commonly made in autoplastic operations in the vicinity of natural cavities and other parts.

The elliptical, 0 or almond-shaped and circular incisions are made as preliminaries to the excision of the tissue included within their circumference. The former is generally made over the surface of large tumours, inflammatory cystic enlargements, and around indelible scars, especially in front of the knee, so that the included tissue is removed, in the first two instances with the growths, so that when the lips of the wound are approximated by sutures there is firm pressure and no sagging over the wall of the cavity made by the excision; in the last case to remove the scar and then to bring the lips of the wound together by autoplastic methods, as in Cherry's operation for broken knees practised and improved by Vinsot of Chartres and others.

The circular incision is commonly made on the skin covering the antrum and the frontal sinus; the skin included in the circle is dissected off (excised) so that the bone is exposed for the trephine. In circular amputation of a limb or other cylindrical organ the incision is carried round the whole circumference of the part to be excised.

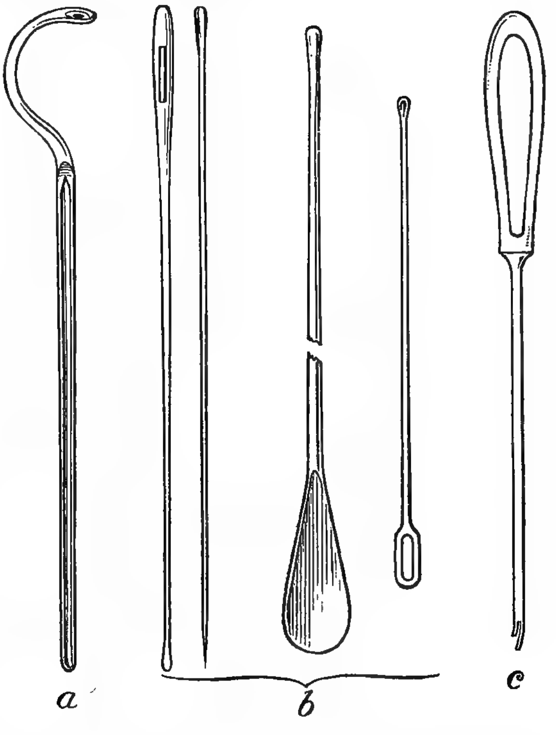

Fig. 274.

a, director and aneurism needle; *b*, probes; *c*, drainage tube introducer.

The semicircular, the U-shaped or ⊔-shaped incisions are made with a view to raising flaps of skin in removing or amputating a portion of a limb.

A transfixing incision is made by passing a long, narrow-bladed knife through the fleshy part, so that its point comes out at the opposite side of a limb to be amputated. The knife should be passed through close to the bone, and then the back turned to the bone and the soft part divided from within outwards in an oblique direction so as to form a flap. After one flap is made the knife should be passed through the other side of the bone, and the process repeated so as to form another or opposing flap. The two flaps brought together by sutures form a covering for the stump.

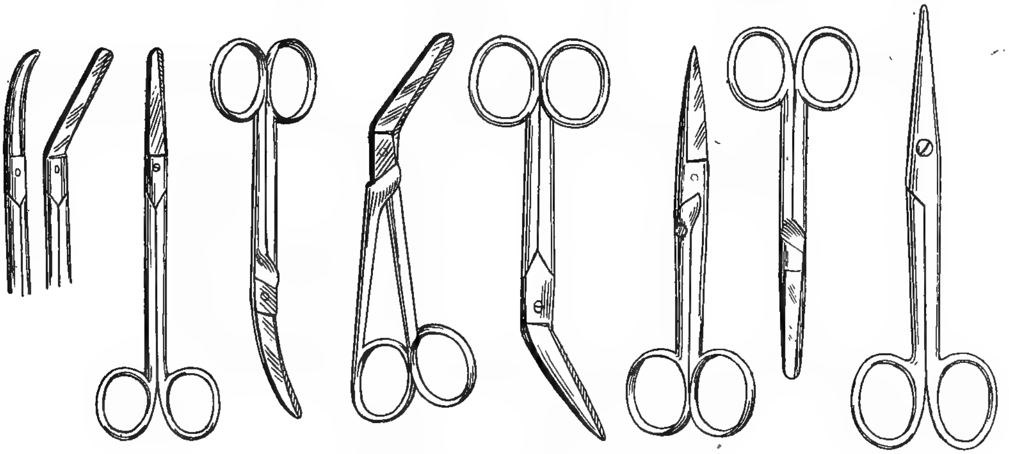

FIG. 275.—Various patterns of scissors.

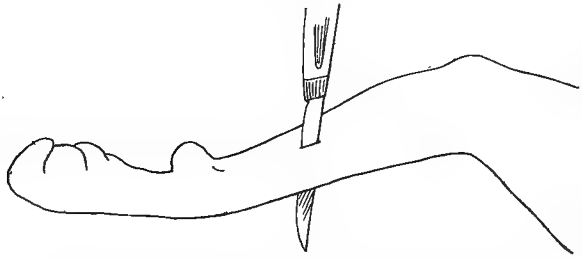

FIG. 276.—Limb of dog showing knife in position for incision by transfixion in amputation.

Injections

These are made with the object of introducing drugs, sera, vaccines, viruses, fluids, and nutrients into the system, or of removing by irrigation excretions, exudates, sera, and morbid secretions from cavities.

They are introduced into the thickness of the skin, beneath it, into muscular tissue, serous cavities (thorax, pericardium, spinal canal, and joints), the nasal chambers, trachea, œsophagus, stomach, intestine, bladder, urethra, vagina, uterus, and blood-vessels.

Intra-dermic injection is made by a hypodermic syringe provided with a short, hollow needle with a sharp point, which is passed obliquely into the thickness of the skin (Fig. 277, *c*). It is used to introduce a local anæsthetic, which does not always remove sensitiveness of the thickened or inflamed skin when introduced subcutaneously. Further it is used to introduce carbolic acid or drugs into the substance of the derma in follicular scabies and certain other skin diseases.

Hypodermic injection is carried out in a similar manner, and by the same means with the same objects in view. It is used for the introduction of local anæsthetics, diagnostic biological products, sera, solutions of non-irritating alkaloids, and sometimes irritating mixtures or oils. The needle used is generally longer than that used for intra-dermic injection, and may be passed through the skin either in a very oblique or vertical direction into the subcutaneous, areolar tissue (Fig. 277, *a* and *b*). *Submucous injection* is made into the submucous areolar tissue, such as that beneath the conjunctival membrane of the eyelid, as in the palpebro-conjunctival test with mallein or tuberculin,

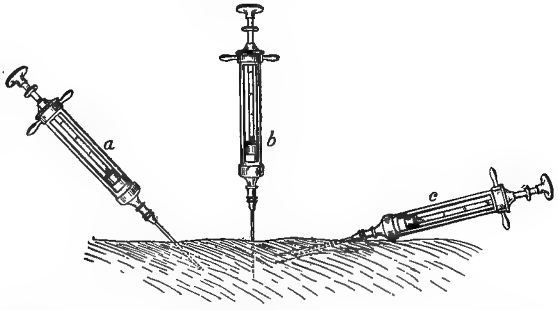

FIG. 277.—Illustrating three directions of passing the hypodermic needle through the skin or into the tissues.
a, oblique; *b*, vertical; *c*, very oblique.

or into the sub-conjunctival areolar tissue covering the eyeball, for the introduction of a solution of iodine or biniodide of mercury (potassio-mercuric iodide) in the treatment of specific ophthalmia in the horse.

Intramuscular injection is made through a long needle. It is adopted for the introduction of drugs such as quinine, strychnine, veratrine sulphate, mercury, arseniate or antimony compounds which usually cause too great an irritation leading to suppuration when injected into the subcutaneous areolar tissue.

Intravenous injection or infusion of solutions into a vein may be carried out by the use of a serum syringe provided with a suitable hollow needle passed into the vein in an oblique manner (Fig. 277, *c*) towards the heart. Care must be taken that it is not passed through both walls of the vein or the fluid may pass into the perivascular areolar tissue and set up irritation, suppuration, or sloughing. After the vein has been raised by pressure on the cardiac side the needle or cannula should be passed obliquely, and when it enters the vein blood will flow through the needle. In the horse and ox intravenous injection is usually made into the jugular vein; in other animals, into the auricular, facial, or external tibial vein. If a syringe is used the fluid must be injected slowly in order to avoid sudden overpressure in the right heart. When it is allowed to flow from a container held some distance above the animal the fluid falls in by hydrostatic pressure. Care must be taken that air is not allowed to enter the vein in order to prevent air-embolism or perhaps intra-cardiac hyperpressure, which may cause sudden death. In lieu of these instruments a vein may be raised or taken up and then incised and the fluid injected by a quittor, glass, or other suitable syringe with a fine pipe previously sterilized by boiling. All material to be infused should be sterilized beforehand.

Sera, artificial serum, weak solution of formalin, solution of chloral hydrate, plain water, solution of iodide of potassium, or of barium chloride, cannabis indica, chloralose, veronal, and other rather insoluble hypnotics may be introduced into the circulation in this manner. Intravenous injection has the advantage over the other methods of injection of producing prompt or immediate action of the introduced drug.

Transfusion of blood from animal to animal of the same species is rarely had recourse to in veterinary practice. But in the case of valuable animals suffering from idiopathic anæmia following some infectious process, or from traumatic anæmia due to loss of blood occasioned by an injury, parturition, or a surgical operation, there is no reason why it should not be used more than it is, especially as the donor or animal supplying the blood can readily be obtained.

The blood may be introduced directly from one animal (the donor) into another (the recipient), or indirectly by the introduction of defibrinated blood.

In *direct* transfusion the blood from the donor is carried to the recipient by sewing together the ends of two severed blood-vessels in a manner that when the blood is allowed to pass there is no leakage from the union, the flow is uninterrupted, and there is no clotting. It is, however, a very tedious operation and requires care. The cannula method of blood-vessel anastomosis has replaced it. For details of both operations the reader should consult Crile's classical work on *Hæmorrhage and Transfusion.*

Indirect transfusion with defibrinated blood was recommended by Panum of Copenhagen in 1865 as a means of lessening risk of the introduction of clots into the circulation. During the last three decades it has been displaced by the use of simple saline solution, which is more readily obtained and safely introduced.

Normal saline solution may be safely introduced subcutaneously, intraperitoneally, intratracheally, or by the stomach in the herbivora, or by the rectum in all species.

Hypodermoclysis, or the introduction of fluid such as normal saline solution, horse-serum, or other therapeutic agent under the skin by means of hydrostatic pressure, is a very safe method, and is largely used in anæmia and shock from loss of blood, in gastritis, enteritis, toxæmia, and septicæmia. In shock, adrenalin is often added to the physiological solution.

The fluid is placed in a glass container or douche apparatus, which is fixed to a wall or held three or four feet above the animal, to which it is connected by means of rubber-tubing provided with a pinch-cock and fitting on to a long serum needle, which is passed obliquely under the skin where there is much loose areolar tissue, notably behind the shoulder in the horse and anywhere along the back in the dog (Fig. 278).

The fluid, which falls by its own weight, should have a temperature 4° to 10° F. above that of the animal's normal temperature; it should be sterile and not irritating to the normal tissues. As much as a gallon of fluid may be introduced at one time and repeated when thought advisable—this is for the horse; for the dog, up to a pint or more according to the size of the animal.

The injection should not be repeated at the same spot until two or three days have elapsed, so as to avoid causing undue irritation. It may be mentioned that in the dog unsterilized tap-water when infused into the areolar tissue does not cause any palpable injurious effect.

Enteroclysis, or the introduction of normal saline solution or other therapeutic fluid into the bowel, is a very useful method to adopt in dysphagia, gastritis, gastrotomy, enterotomy (small intestine), in shock, loss of appetite. The bowel should be emptied, if possible with an enema.

The fluid should have a temperature of 110° F., and no more than the animal can bear comfortably should be infused at one time, else it will be expelled. Irritating material should be mixed with some bland mucilaginous material, as linseed or starch mucilage. The absorptive power of the rectum and colon is very great.

The slow introduction of fluid by hydrostatic pressure is preferable to the method of introducing it by forcible means.

In the herbivora great quantities of saline solution and other therapeutic fluids may be introduced into the stomach by means of an œsophageal tube, passed through the nostril or the mouth, attached to a high container or even a funnel. In the carnivora this method is useful for stomach lavage in gastritis, ingestion of poison, gastric tympany, and overloaded stomach.

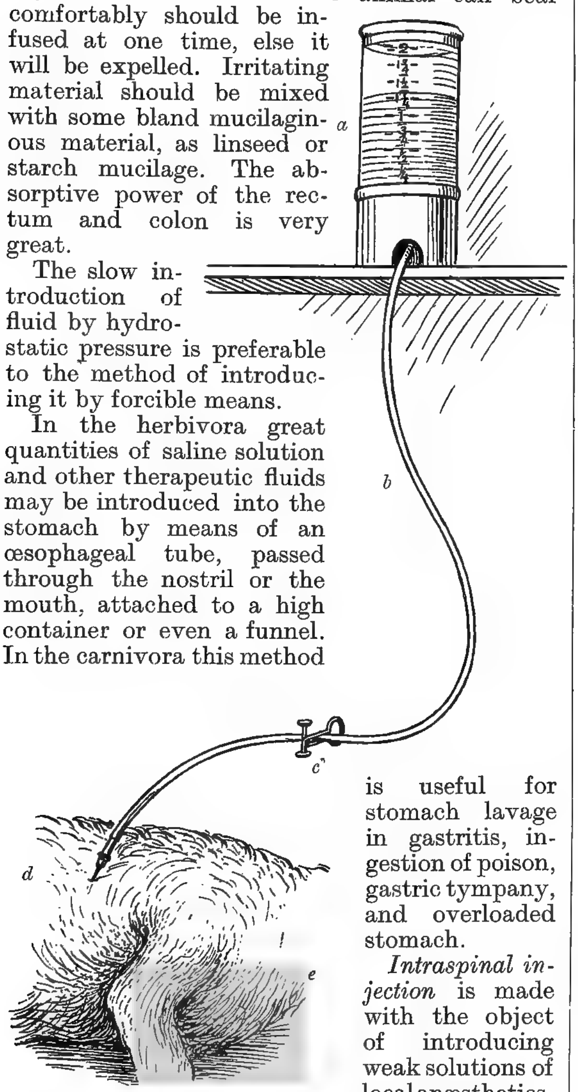

FIG. 278.

a, reservoir or container; *b*, rubber outlet tube; *c*, pinch-cock; *d*, needle; *e*, patient.

Intraspinal injection is made with the object of introducing weak solutions of local anæsthetics, as cocaine hydrochloride, novocain, and especially stovaine, into the spinal sheath in the lumbar region for the purpose of anæsthetizing the posterior part of the abdominal region and hind quarters. The injection can also be made in the cervical and dorsal region, but strychnine should be added in order to prevent disturbance of the heart's action.

This method is, however, not without danger, and the mortality from it is greater than that from general anæsthesia. For practical purposes in veterinary surgery it is inferior to general anæsthesia, and requires greater skill and much more care to carry it out successfully. For further details see the section dealing with ANÆSTHETICS.

Intratracheal injection is used to introduce medicaments into the trachea and bronchial tubes, as in parasitic bronchitis (hoose, husk, or gapes), purpura hæmorrhagica, gangrenous pneumonia, and in chronic laryngeal irritation causing a persistent or chronic cough; also for the purpose of rapidly introducing a quantity of normal saline solution or even plain sterilized water into the system in collapse from profuse hæmorrhage. Chloroform injected into the trachea rapidly destroys life in a painless manner.

Injections of sterilized water, saline solution, iodine solution, etc., may be made into the thoracic and peritoneal cavities. Fluids—nutrient, medicated, or macerating—may be injected through a cannula passed through the abdominal wall into the stomach or intestine.

Injections or *irrigations* are made into the nasal chambers and sinuses, the Eustachian tube and guttural pouch, trachea, nasal duct and lachrymal canals, conjunctival sacs, mouth and salivary ducts, œsophagus, stomach, and rectum, including the anal pouches, the vagina and uterus, the sheath, urethra, and bladder, and the cavity of the external ear; into the pleural, pericardial, and peritoneal cavities, and also into deep and sinuous wounds, abscesses, cysts, and bursal distensions, with the object of removing excretions or secretions or of introducing caustics, antiseptics, astringents, sedatives, or anæsthetics.

In the œstral female injection of semen collected from the male is made into the vagina or uterus with the object of inducing artificial impregnation, and anticonceptic fluids, such as quinine, sulphate of zinc, chinosol, or permanganate of potassium, are injected to prevent conception from a *mésalliance.*

Injections are made by means of syringes which force the fluid into the channels or cavities, or by irrigators, which are reservoirs containing the fluid, which falls or flows by its own weight through rubber-tubing provided with special nozzles.

These reservoirs, made of glass, earthenware, wood, or metal, are placed some distance above the height of the animal; they are either provided with an outlet at the bottom or at one side towards the base, to which the rubber-tubing is affixed. In lieu of special reservoirs any vessel such as a pail, tub, jar, or even a tin canister may be used, as the fluid can be siphoned off by allowing one end of the tube, which has been weighted, to fall to the bottom of the vessel, and the other and longer part to fall over the side of the vessel. In order to prevent kinking or compression of that part of the tube meeting on the upper edge of the vessel it should be provided with a semicircle or U-piece of hard rubber, glass, or metal tubing. The flow is started by aspiration or sucking the end of the outflowing or longer tube.

In irrigation of the uterus of the larger animals, as the mare and cow, the fluid should be withdrawn by siphonage soon after its introduction, in order to prevent its retention and absorption. A suitable apparatus for this purpose is a long rubber tube provided with an aspirating bulb similar to that of Higginson's syringe.

In the smaller animals, as the cat and bitch, the uterus may be emptied of fluid by raising the fore parts of the animal and compressing the abdominal walls towards the pelvis or by giving the animal a run. By this method a retained afterbirth may be evacuated. The temperature of the injected fluid should be from ten to twenty degrees higher than the normal temperature of the animal. Whether the fluid be forcibly injected by a syringe or allowed to inflow by its own weight, care should be taken not to force in air. This can be obviated by expelling fluid through the nozzle before the tube is passed into the uterus.

For continuous irrigation of the limbs a special nose-piece, provided with a series of outlets and capable of being fixed round the limb by means of a strap, is necessary. For deep, septic wounds one or more perforated tubes are essential; these pipes or tubes should come directly in contact with the walls of the wound, and in those wounds with a wide outlet they should be covered with pads of lint, spongiopiline, or some other absorbent material (Fig. 279). For intermittent irrigation the outflowing rubber-tubing should be provided with a pinch-cock to regulate the flow (see Carrel Treatment under section of Sodium Hypochlorite in article on "Antiseptics").

The syringes generally used for the injection of open cavities, channels, deep wounds, or sinuses are of the simple kind, composed of a barrel enclosing a piston connected with one or three finger-rings, a handle, or finger-piece at the external extremity, and a nozzle or nose-piece through which the fluid is forced. They are made of glass, metal, or vulcanite. They vary in capacity from two drachms to a quart. Certain of the smaller syringes of the simple kind are, however, provided with a glass barrel and metal or vulcanite mounts and pipes.

The larger syringes for enemata are generally provided with a thick, smooth pipe or nozzle. This pipe, which may be of brass, pewter, tin, wood, or vulcanite, varies in length from 4 to 16 inches according to the size of the syringe. A syringe for the larger animals should have a capacity of a quart, and one for the smaller animals, as the dog and cat, should contain from 4 to 10 ounces. Syringes with a metal plunger should be preferred, as those with leather plungers frequently require repacking and frequently cause much inconvenience. Read's enema pump, with a long suction-tube and an outlet tube of several feet of rubber, gum-elastic, or spiral metal-tubing provided with a pipe for the rectum, is commonly used as an enema syringe. When the long outlet tube is fixed on the suction extremity of the pump it acts as an aspirating pump to empty the stomach of fluid contents. Read's pump may be used for irrigating the nasal chambers, the uterus and bladder, or for withdrawing fluid from these organs.

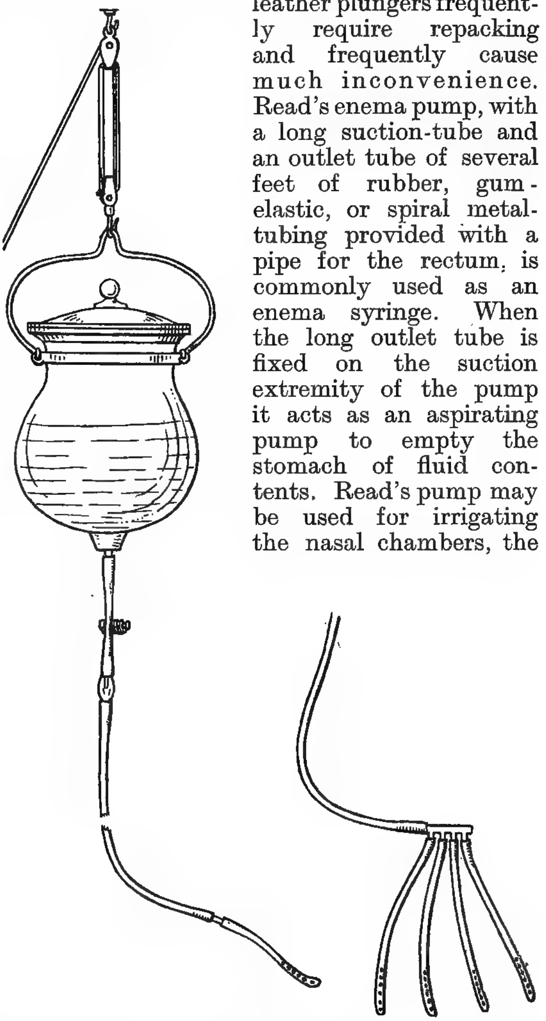

Fig. 279.—Reservoir or container with pulley, outlet tube with pinch-cock, and terminal sprays or rose-tubes.

Higginson's pattern of syringe is composed of rubber, and provided with a vacuum ball and valve. It forms an instrument for the administration of enemata, for irrigation of cavities, channels, and wounds. When supplied with rubber-tubing and a suitable nose-piece at the inlet end it acts as an aspirator; and with a hollow needle or cannula, for the evacuation of cysts, effusions in cavities, etc.

Any simple syringe having affixed to it a catheter, hollow needle, or cannula may be used as an aspirator when the air in the barrel has been exhausted.

For deep wounds and for cavities such as the uterus and bladder, fluids should not be forced in under too great pressure nor in large quantity unless through a double tube, as instances have come under the immediate notice of the writer where sudden rupture of the viscus has occurred from neglect of these precautions.

Warm or even hot solutions are generally more efficacious than cold ones, notably in case of acutely inflamed mucous membranes. For injection of quittors, small wounds, and small cavities and channels a brass syringe of one or two-ounce capacity and fitted with a suitable pipe or catheter may be used. For injection of the anal glands in the dog the pipe should be of small calibre and have a fine, bulbous extremity. For the nasal duct the pipe should be in the form of a fine catheter and passed up the nasal extremity of the duct or down the lower lachrymal punctum. In animals other than the horse the nasal duct can only be irrigated from the lower lachrymal punctum.

For the introduction of medicaments, diagnostic agents, curative and preventive sera and vaccines into the veins, depth of the tissues, and closed cavities, various patterns of special syringe with hollow needles or cannulæ are used. Those made of glass are too fragile, as the slightest movement on the part of the animal during their use is liable to fracture them, whilst those composed entirely of metal hide the contents so that the operator cannot observe the progress of the injection. In consequence of these objections syringes composed of a glass barrel and metal mounts are preferred. The component parts being detachable, they may be taken to pieces for cleansing and sterilization. Syringes provided with vulcanite mounts, piston rod and plunger cannot very well be sterilized without damage, and therefore should be discarded.

The plunger should be composed of asbestos, rubber, or preferably metal, never of leather or cotton. The capacity of the barrel varies from 2, 4, 10, 15, 20, 30, 40 to 100 c.c., the graduation being engraved on the outside of the glass barrel or on the piston-rod. For injection of a quantity of fluid or serum under the skin or into a vein, a length of 4 to 6 inches of rubber-tubing with fitments at each extremity is often used in order to do away with the rigidity of the instrument, to prevent breakage of the needle, or an accident owing to sudden movement of the animal.

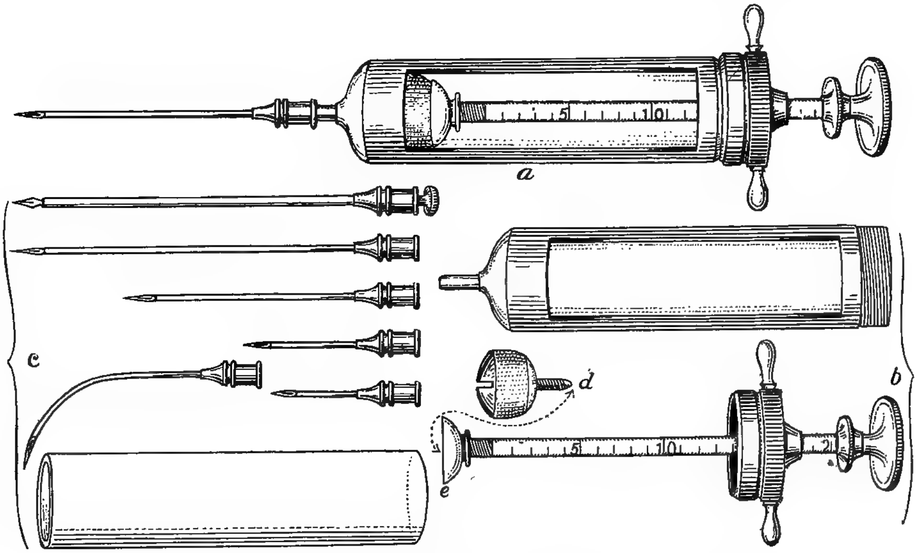

FIG. 280.—Roux's serum syringe.

a, assembled for use; *b*, in parts; *c*, trocar and cannula, and various needles; *d*, rubber plunger and screw; *e*, cup on piston for reception of plunger and screw.

Roux's syringe (Fig. 280) is a very reliable instrument, and is constructed so that its component parts may be detached and submitted either to wet or dry sterilization. The graduation is engraved on the piston-rod, which carries a rubber plunger, fixed by means of a double grooved-headed screw. The plunger may be tightened or expanded by turning the head of the piston. The glass barrel is absolutely detachable, and as it is plain it is not very costly to replace if it should be broken.

Roux's syringe is economical in price and is usually sold with a number of rubber rings, plungers, and glass barrels. When the syringe is not in use the parts should be relaxed and put away in a sterilized condition. Before being used again a few syringefuls of sterilized carbolized water should be sucked up and pumped out, in order to soften the rubber fitments and to discover leakage of fluid or air.

For general veterinary use the "Record" syringe is one of the best, as it is simple in structure, and with proper care it is not liable to get out of order (Fig. 281). The mounts are adherent to the glass barrel, which has the graduations engraved on it. The plunger is of solid metal and accurately fits the glass barrel. Immediately after use the plunger should be withdrawn, or the fluid left in the barrel and on the plunger in drying may fix the plunger to the barrel and render the instrument useless. In the sterilization of this syringe and, in fact, any syringe having a solid metal plunger, the plunger must be removed, as on cooling the glass barrel contracts much more rapidly than the metal plunger and in consequence may fracture. Syringes like this one with adherent metal mounts or with soldered parts cannot be sterilized with dry heat, as the soldered parts give way.

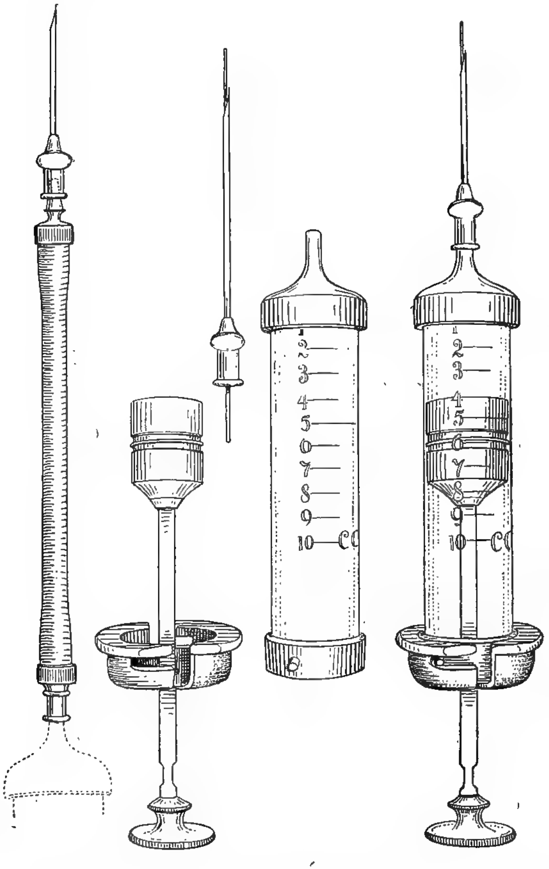

Fig. 281.—"Record" syringe with solid metal plunger and extending rubber-tubing.

Hollow needles varying in length from $\frac{3}{4}$ to 3 inches and of various gauges are made, the shorter ones being useful for intradermic, hypodermic, and intravenous injection, and the longer ones for deep intracellular or intramuscular and also for intraspinal injection. They are usually curved for intratracheal or intraperitoneal injection. For tough tissues a needle in the form of a small trocar and cannula may be necessary.

The finer the calibre of the needle the easier it pierces the tissues, but it is very fragile and it may be broken if the animal move suddenly during the operation. The needle points are either lancet-shaped, trocar-pointed with a lateral orifice or two, or more or less chisel-shaped, or they may be truncated like the point of an ordinary cannula. Immediately after use they should be boiled and then dried before the stylet is replaced and they are put away. Subjecting them to a high temperature or keeping them too long in the flame destroys the temper of the metal, and when it does not cause unsoldering of the head it renders the point soft and blunt.

If syringes and needles cannot be cleaned for some time after their use, it is a wise precaution to place them in a wide-mouth bottle containing a 5 per cent solution of lysol, which not only cleanses them but also prevents the steel rusting.

When exhausted of air these syringes may be used as small aspirators for emptying cysts, the bladder, and other closed cavities of small animals.

Setoning

Setons are used for making a subcutaneous wound either to set up irritation and produce suppuration or with the object of causing counter-irritation. They are used sometimes as a means of draining a sinuous or pocketed wound or a cystic, hæmorrhagic, or purulent cavity such as inflammatory bursæ (capped elbow, capped knee), poll-evil, fistulous withers, hæmorrhage into a lymphatic space (hæmatoma in intermuscular space of the external ischio-tibial region), and parotid abscess (strangles). They are often used to drain sinuous wounds of the coronet and also as counter-irritants in certain conditions of the foot. In the treatment of gathered nail or its effects they sometimes produce a marvellous result, the lameness disappearing after other methods of treatment have failed.

As a means of setting up counter-irritation setoning is less used than formerly, but for drainage it is still one of the most serviceable in veterinary practice. The seton is much less likely than tubing to be displaced by the movements or the teeth of the animal.

Seton needles are generally straight, semicircular, or more or less curved. They vary from 1 to 18 inches in length and are either flattened from front to behind or from side to side, or oval in diameter. They are about ¼ to ½ inch in width and usually have an oblong eye either in a transverse direction or following the long axis of the needle; this eye may be either at the head or within a short distance from the point. Some needles have an eye at both ends. The point is blunt or probe-pointed with a ridge running in the centre of the upper surface (Fig. 282, *a*), or sharp (Fig. 282, *b*); and sometimes bevelled on the margins (Fig. 282, *c*). Some French patterns are made up of two, three, or four sections which when screwed together form a long needle, the stem of which is usually oval in diameter, straight, provided with a slit-like eye at each end and a bevelled and thin cutting-point (Fig. 283, *a*).

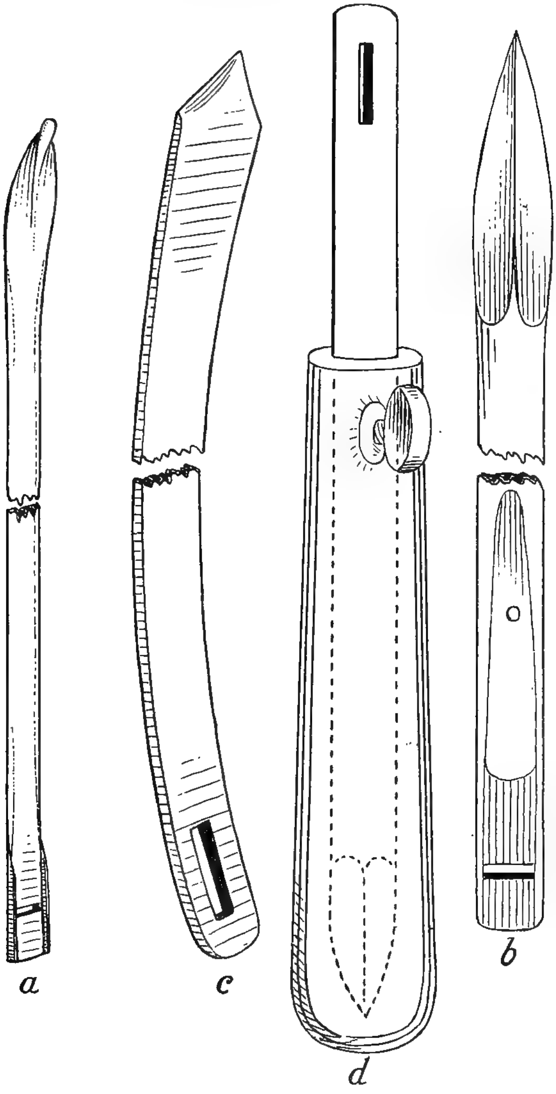

Fig. 282.—Seton needles.

The needle used for frog-setoning is full-curved, flattened on the curve or from side to side, with an eye at one end (Fig. 284, *b*). That used for dewlap-setoning of young cattle is slightly curved on the flat, with an eye at either end and a bevelled angular cutting-point; it is about 7 inches in length (Fig. 282, *c*).

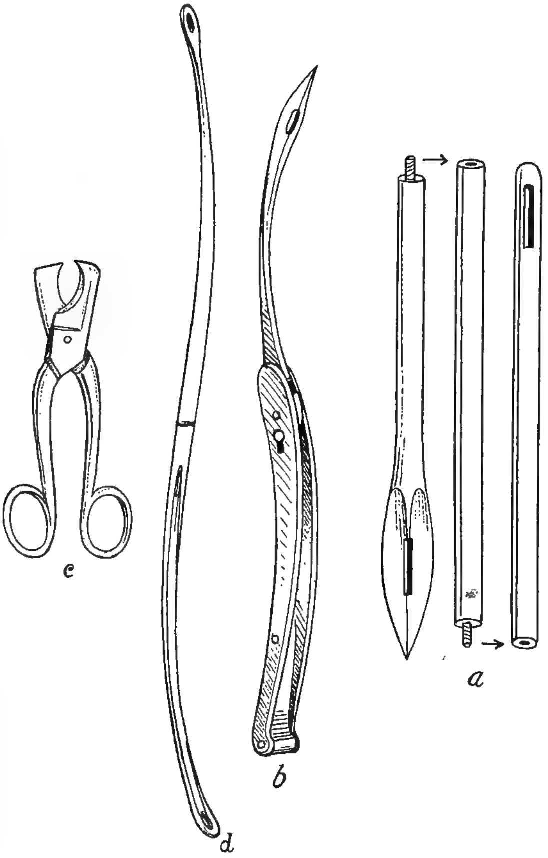

Fig. 283.

a, *b*, *d*, seton needles; *c*, rowelling shears.

For small setons or for passing large-size suture material, such as narrow linen or fibre-tape, through large wounds, the labia of mares, cows, and sows, or the walls of the anus, to prevent recurrence of prolapse of the uterus, vagina, or rectum, the small long-curved seton-needle of Gerlach (Fig. 283, *b*), with an oval eye in the thin, flat, sharp cutting-point, is a very useful instrument. This needle is also useful for setoning in dogs and other small animals.

The blunt needle may be used for passing a tape through sinuous wounds or suppurating cavities in order to form a drain, but when it is required to pass a seton through intact skin, incising at the points of entrance and exit must be made with a sharp scalpel, rowelling scissors (Fig. 283, *c*), or a bistoury. The advantages of a blunt-pointed needle is that when it is being passed through it is less likely than a sharp needle to pierce important tissues. When much force is required to pass the needle a handle may be attached to it and fixed by means of a small thumbscrew or other fixing attachment (Fig. 282, *d*). For long sinuous wounds, instead of a seton-needle, whale-bone probes of various lengths, and provided with a slit-like eye at one end for tape, may be used as seton carriers, and are preferable because of their relative flexibility. For curved sinuous wounds the French S-curved metal sound may be used to pass the seton (Fig. 283, *d*). It is a very useful instrument and is provided with grooved extremities, each of which with an eye, and it can be disjointed into two pieces. The curved grooves form a director or cannulated sound.

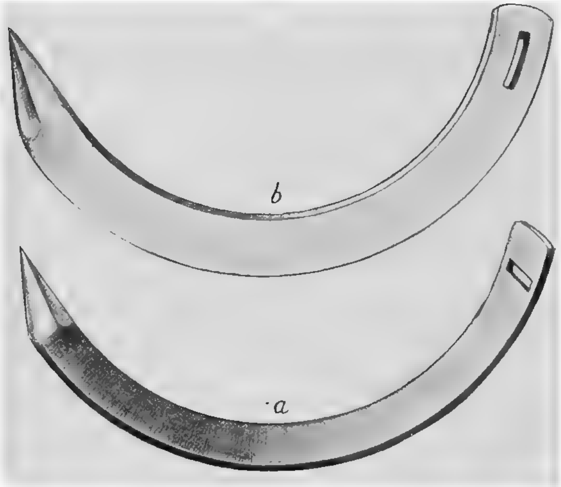

Fig. 284.—Curved seton needles.

The sharp-cutting, pointed seton-needle may be pushed through the skin, but care should be taken when it is forced through the deeper tissues that it does not divide important structures such as tendon, nerve, or blood-vessel, or penetrate a joint.

In frog-setoning the horn should be thinned at the point of entrance of the needle, and the needle should enter the frog midway between the apex and the bulb and emerge at the hollow of the heel. The ends of the tapes should be tied together, and dressed daily. The wound should be kept clean and any underrun horn should be removed in order to allow the escape of pus. The seton should remain in as long as lameness is present.

Material for Setons.—The material used for setons is usually tape, which may be either medicated with iodoform or introduced plain, and afterwards dressed from time to time with oil of turpentine, terebene, carbolized oil, or blistering ointment. The tape is made of unbleached linen or of fibre. Thin lamp-wick or lamp-cotton, and for small animals, string, cord, silk, or worsted, may be used. Plaited horse-hair forms an excellent material for drainage purposes; it does not cause so much irritation as the tape formed of vegetable material.

The seton should be dressed from time to time to disinfect it or to maintain irritation according to the case, and sometimes the tape should be replaced by a fresh one.

If left in too long it is liable to produce necrosis of the skin, and eventually fibrous thickening and retraction. As soon as the seton tract becomes prominent the tape should be removed, the wound disinfected, and, if necessary, a fresh seton inserted.

The seton is maintained in position by making a bow-knot at each end or by tying the two ends together. Precautions should be taken to prevent the loop being caught and torn out by the animal.

A rowel is a disc-shaped piece of leather or felt—like a gun-wad—inserted beneath the skin to create an issue over the diseased part. The rowel is perforated in the centre and two threads are attached to it for the purpose of moving it when in position. The rowel, dressed with an irritant, is bent double and inserted through a small opening made in the skin by rowelling scissors—which are provided with a hook designed for making the space within the incision for the accommodation of the rowel, which is flattened out after insertion. From time to time the rowel is rotated in position by means of the threads. It should be kept in place for about a fortnight, and after its removal the wound should be disinfected as may be required.

Firing or Actual Cauterization

Firing or actual cauterization is a method of treatment which is carried out by means of an instrument termed the firing-iron, which is heated to a degree that will, when brought into contact with the tissues, coagulate their albuminous constituents, producing an acute inflammatory condition or destroying the anatomical elements themselves.

There are various forms of cautery, some of which are heated by placing the head, composed either of iron, steel, or copper, in a fire, and others which have the heat generated by combustion of volatile fluids, as benzol, petrol, or ether, contained within the hollow of the stem.

The ordinary firing-irons are formed of a special head connected with a fixed or detachable handle, or a cylindrical iron stem. They vary in length from 12 to 30 inches. The head is continuous with the stem either in a straight line or at right angles; sometimes the stem meets the centre of the back or base of the head as in the searing-iron used in amputation of the tail of the lamb, or in the centre of the vertically cylindrical head as in that used in docking horses.

The head has a thickened base and generally a thinner penetrating edge or point; it is either hatchet-shaped, in the form of a semilunar turf cutter, a more or less pointed or obtuse cone, bulrush-shaped, or like a sharpened pencil. The instrument used for penetrating sinuous wounds in the coronary region of the foot to make a counter-opening for drainage purposes has a fine-curved or straight point gradually tapering from the stem.

These irons, shown in the accompanying illustration (Fig. 285), are heated to a red or white heat in either a wood, charcoal, coke, or coal fire, or in a small gas, paraffin, or petrol stove, lamp, or furnace as used by plumbers.

Besides these ancient firing-irons there are special self-heating cauteries with various shaped heads, from a fine cylindrical point to that of a chisel or hatchet, made of platinum, copper, or steel, heated by volatilized ether, benzoline, petrol, gas, or electricity. Some of these, such as that of Paquelin, La Place, or the Zoö-cautère, require an attached rubber bellows to force the unheated vapour into the carburettor to be heated. Others, as that of Déchery and that of Beach, volatilize the spirit automatically after the neck and head have been started by being heated over a spirit-lamp.

Platinum or copper-point cautery attachments may also be heated by means of a bichromate battery, or by an electric light accumulator charged from a dynamo, from the electric light main, or other source of direct-current electricity, but as these methods of heating are very expensive they are generally precluded from veterinary practice.

Small cautery points of various shapes, made of platinum or of spiral-shaped porcelain, may be heated from the main after the current has passed through a transformer or rheostat. They are attached to a special handle provided with a thumb and two finger rings and also a trigger, which, when drawn continuously, starts and maintains the current. It is connected to the transformer by means of a positive and a negative wire. The handle, when fixed up with a snare cannula through which a loop of steel wire is passed, acts as an electric cautery écraseur, and is especially useful in canine and feline practice.

The transformer or rheostat may also be used for small surgical lamps; but the more powerful ones are suitable for either galvanism, faradism, or electrolysis, and also for higher candle-power lamps.

The specially constructed larger cauteries, capable of being heated direct from the electric or gas main, are suitable for firing or actual cauterization of the larger animals in veterinary infirmaries in towns where gas or electric light is ready at hand. In the case of the electric cautery the apparatus proper is connected to the plug by means of long wires, and that of the gas-heated cautery by means of a long rubber tube fixed to a tap in a gas-pipe receiving its supply from the gas-main. Both these instruments are made on the principle of the plumbers' electrically or gas-heated soldering-iron.

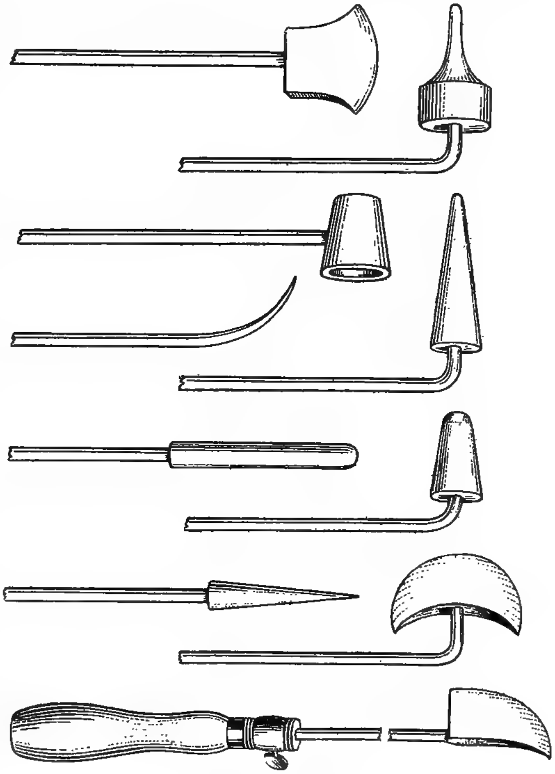

Fig. 285.—Firing-irons.

For linear firing, excision, or hæmostasis the various forms of the ancient firing-iron heated in a fire or a stove, with the exception of the larger cautery irons heated by direct supply from the gas or electric main, are superior in action to the modern automatic apparatus, whose points generally cool too rapidly when in contact with the tissues for efficient use.

For coarse or heavy horses with thick skin a heavy and thick-headed iron is necessary, but for well-bred and young horses in which the skin is thin or very sensitive to irritation a thin or lighter iron is preferable.

The smaller irons as used in human surgery are suitable for canine and feline practice.

For penetrating point-firing, superficial or deep, the best instrument for this purpose is Déchery's automatic firing apparatus, as it makes a narrow puncture and as deep as the point will allow if one desires it. It is less likely to blemish than the large conical-headed irons used in former days by British veterinary practitioners, and it also does away with the trouble of repeatedly heating such irons, which rapidly become cool. It is an excellent instrument for deep puncture-firing in canine practice.

The temperature at which a cautery should be used depends altogether upon the object in view. If it is to be used for its counter-irritant and destructive effect it is best employed at a high temperature, as from a bright red to a white heat. When used as a hæmostatic the cautery should not exceed a dull-red heat, or the blood-vessels may be rendered too rigid before a proper clot is formed, and hæmorrhage may continue or recur. When used at a black heat the tissues are liable to adhere to the iron, but this can be prevented by applying a little lard or oil to the tissues before using the iron.

As a general rule the pain caused by a bright red or a white-hot iron applied to the skin is momentary; it is not much more than a sharp twinge. This is explained by the fact that the nerve terminals in the superficial layers of skin are rapidly destroyed. On the other hand, an iron at a temperature just below that of a dull red heat does not char the superficial layers of skin, but powerfully stimulates, so that serum is poured out and perhaps the albuminous constituents are coagulated, and it causes great pain which lasts for some time.

The cautery should not be used in the early stage of inflammation, nor when there is suppuration or any œdematous condition. It is indicated in long-standing, deep-seated, inflammatory conditions of the joints, bones, and tendons, especially when accompanied by thickening of the parts affected, by great pain and much lameness. It is then an efficient counter-irritant and analgesic, and stimulates the reparative process into greater activity. Its action is similar to, but much more powerful than, that of vesicants or other revulsives.

For chronic articular and osseous inflammation deep-point firing with a fine-pointed instrument such as Déchery's is preferable to line-firing. The points should penetrate the skin and reach the periosteum, which should be pierced. Care should be taken not to open an articular cavity. The punctures should not be too close together, as the intervening skin would be liable to undergo necrosis and cause a permanent blemish; they should not extend beyond the part affected.

In the case of chronically inflamed and thickened tendons, ligaments, or bursæ, line-firing, with the addition of a few penetrating points in the actual tissues involved, acts very beneficially by easing or removing pain, stimulating the reparative process, and, after the partially divided skin has cicatrized and contracted, by forming a firm support to the damaged tissues. When a fine and rapidly-penetrating pointed iron is being used on tendons care should be taken to avoid penetrating blood-vessels or damaging nerves. In line-firing the lines should not be too close together, nor should the entire thickness of the skin be divided. The lines should not run into one another nor be crossed so as to isolate parts of skin, as sloughing is liable to occur.

Before firing a limb the hair should be removed with a clipping machine in order to prevent the hair catching alight and obscuring the view of the operator, and in those cases where the skin is thickened and greasy the part to be operated upon should be well washed and scrubbed with soft soap and hot water so as to remove as much as possible of the dirt and loose horny epithelium. With the object of removing sensation from the part, and therefore preventing the animal resisting the operation, an injection of a freshly-prepared 5 per cent solution of cocaine hydrochloride should be made along the course of the sensory nerves above the site to be fired fifteen to twenty minutes before commencing, and renewed if necessary during the process of firing.

To prevent undue fatigue on the part of the operator in firing a horse in the standing position, well-balanced firing-irons with rather long stems are preferable to short ones, which are best for the arrest of hæmorrhage, castration, and the removal of peduncular new growths. They should be heated to a white heat and have the loosened scales removed by rubbing them on a slab of soft stone, or by means of a rasp, and as soon as they begin to appear black they should be returned to the fire to be reheated. Some practitioners start with an iron heated to a dull-red heat to mark out the lines, but as a white heat causes less pain it should be preferred.

Horizontal or oblique lines about three-quarters to an inch apart, commencing from above and gradually working down the limb, should be made if the part be the metacarpal, tarsal, or metatarsal region, care being taken that the lines do not extend to the flexure of the knee or hock, nor to the anterior surface of the metacarpal or metatarsal region, where the bone is subcutaneously situated. In the phalangeal region it is better to make the lines in a vertical or a vertically oblique direction, but it is not advisable to continue them into the hollow of the heel.

The cautery should be held firmly and drawn lightly through the lines several times until the required degree of cauterization is obtained. If only a light degree of firing is desired this will be known by the lines appearing of a yellowish tint, rather shallow in depth and narrow in width. When a moderate degree is the aim it will be recognized by the lines having a wider and deeper appearance, a light brown tint, and issuing a reddish serous fluid. Should deep firing be deemed necessary the iron is drawn over the lines until the lines appear very wide and deep, as if the whitish tissue at the bottom of the furrow were attempting to burst through with an abundance of serous fluid.

After the operation has been accomplished, many practitioners apply a cantharides or biniodide of mercury ointment or a mixture of equal parts of these two to the fired parts with the object of maintaining and increasing the irritation. But in the case of a well-bred and young horse with delicate or tender skin this is a very risky procedure, and often results in sloughing of skin with indelible scars or blemishes. In such cases it is therefore not wise to apply a vesicant until the acute inflammation has subsided, and then only after the parts have been washed and freed from the accumulated discharges. As pain and irritation occur in the cauterized part, the animal may gnaw or bite, or even rub the inflamed skin, and to prevent this the animal should be tied up on the pillar-reins or have a cradle put on his neck.

Twelve hours or so after the operation the parts, especially of the limbs, swell, discharge a thickish, yellowish, resin-like serous fluid, which is irritant, and often more or less large vesicles appear on the skin between the lines. Should the animal appear restless and the swelling be very tense, it should be smeared with carbolized oil, or dressed from time to time with lead lotion or dusted over with dry dressing. When the inflammation set up by the firing has gained its maximum the parts may be irrigated or washed with cold water so as to remove the accumulated discharges and to act as a sedative astringent. In a few days, should the inflammatory reaction not be of the degree required, the parts may be well anointed with a vesicating ointment containing from 8 to 12 per cent of biniodide of mercury, or one containing from 12 to 20 per cent of cantharides, or in the case of well-bred, irritable horses, mylabris, which has a good vesicant action, but does not make the animal restless. The blister should be applied with friction continued for a quarter of an hour or more so as to ensure thorough penetration of the skin.

Should there be intense inflammatory reaction, evidenced by excessive swelling, pain, and profuse suppuration, it should be subdued by irrigation with cold water, preferably from a hose-pipe.

In chronic arthritis of the hock, pedal, or coronal joint, or in periostitis, point-firing is more efficacious than line-firing, as the cauterization is brought to bear directly on the tissues involved, and does not cause so much pain nor liability to disfigurement. It is better carried out by a fine-pointed instrument such as the Déchery automatic apparatus than by the old-fashioned, clumsy, conical-pointed iron which quickly cools, necessitating repeated heating, and making a large circular puncture in the skin.

Point-firing with Déchery's apparatus is an excellent method of producing counter-irritation in chronic articular disease, ostitis, and rheumatic arthritis in the dog. The part or region, usually the shoulder-, hip-, or stifle-joint, is rendered insensitive by a few injections, made at various depths, of a 2½ per cent solution of cocaine hydrochloride or other local anæsthetic. As in the case of the horse, the punctures in firing must not be made too close together. The punctures may be anointed with mercurial ointment well applied, care being taken that the superfluous ointment remaining on the skin is wiped off. The writer can testify to the efficacy of this treatment in chronic inflammatory changes in the vicinity of the hip, stifle, shoulder, or other joints after all other methods of treatment for months had failed.

This system of firing, long carried out in France, is also very effective in the reduction of bursal distensions, but care should be taken to avoid puncturing the serous cavity.

The straight cylindrical pencil-pointed iron having a diameter of an ordinary lead pencil is useful for puncturing the wall of cysts or abscesses, cauterizing chronic sinuses, or for the arrest of hæmorrhage. It is also useful under certain precautions for the penetration and destruction of chronic suppurating anal glands and the soft fungating adeno-carcinomata in the substance of the anal walls so commonly encountered in aged dogs.

In the removal of the testicle the iron should be of a black heat, but in order to prevent the tissues adhering to the iron, lard or green ointment is smeared on the cord just above the clam or clamp. The degree of cauterization employed in this method is more likely to prevent hæmorrhage than that obtained by the use of a red or white-hot iron, which chars the tissues, renders the vessels rigid or brittle, and leaves a foreign body in the wound. Moreover, the risk of secondary hæmorrhage is increased. The black-hot iron coagulates the albuminous constituents of the tissues, which curl up and occlude the lumen of blood-vessels. This is very noticeable in the castration of fat lambs about two or three months old, which bleed much after being castrated by a red or white-hot iron, and many succumb from malignant œdema or gaseous septicæmia arising from decomposition of blood-clot remaining in the scrotal wound.

Amputation of the tail in lambs is often effected by a cautery shaped in the form of a spade. By this means hæmorrhage is prevented and a barrier raised against invasion by virulent bacteria. H. G.

OPERATION FOR ROARING

The surgical relief of roaring in horses was first attempted in 1866 by the Professors Günther of the veterinary school in Hanover. Further reports upon the operation were made by K. Günther in 1893 and 1896.

The Professors Günther experimented with a series of operations upon the vocal apparatus, in an endeavour to find a successful method of surgical interference. They removed, in part or entirely, virtually every part of the vocal apparatus, including the arytenoid cartilages, the vocal cords, and the mucous membrane lining the laryngeal ventricles. Their investigations were continued for about thirty years. However, the material available to them was apparently not very extensive. The details of their various plans for operating are not available. In their publications they give merely the outlines and do not record fully the consequences of their operations as revealed by post-mortem examinations. Among the numerous experimental operations which they performed was the removal of the mucous membrane from the laryngeal ventricle without removing the arytenoid cartilage or vocal cords. Like the other experimental operations of the Professors Günther, the removal of the mucosa from the laryngeal ventricle did not succeed, and the literature which they have left upon the subject does not explain why the operation failed.

Following the efforts of the Professors Günther other investigators took up the work. In general they confined themselves to one type of operation—the total or complete ablation of the left arytenoid cartilage, which necessarily involved a partial or total removal of the vocal cord, with some mutilation of the mucosa of the ventricle. Prominent among these investigators were H. Moeller in 1888, Fleming in 1889, and Cadiot in 1891, each of whom published monographs upon the subject, recommending the particular type of operation which he described. In each case, however, the technique proved a failure. A few recoveries occurred, but so few that, one after another, each plan had to be abandoned as wholly unsatisfactory. There were many more horses ruined by the operation than benefited.

Numerous veterinarians in different countries attempted one operation after another, as recommended by various investigators, and occasionally published their results. At first a certain technique would be followed by what appeared to be highly favourable results, but in the end sequelæ would appear and destroy the value of the patient. A great variety of operations were advised, but none of them, except the removal of the arytenoid cartilage, gained any standing with the veterinary profession.

As early as 1890 I had attempted, without success, the operation recommended by Fleming, and later had attempted other plans, consisting chiefly of attempts to fix the vocal cords against the side of the larynx by means of permanent sutures, but these efforts generally failed. In 1905, in the clinic of the New York State Veterinary College, at Cornell University, I began experimental work in the removal of the ventricular mucosa, and in 1906 presented the results before the American Veterinary Medical Association.[1] The investigations were continued, and the following year a further and more encouraging report was made to the same Association.[1] The operation then began slowly to gain a definite place in veterinary practice in the United States. The progress of the operation was exceedingly slow. Only a few veterinary practitioners attempted it. My clinic afforded but scanty material, and each change in technique required much time and some repetition before any conclusion could be reached and a new step taken. So many operations for roaring had been heralded prematurely as successful, and later proved useless or worse, that the profession as a whole looked askance at any proposed plan of surgical interference. The few attempts at operating were confined to the United States. Reports of the investigations appeared in England, but attracted no serious attention. In 1909 I demonstrated the technique clinically, upon two roarers, to Mr. Hobday in England. The results were satisfactory, and Mr. Hobday at once took up the operation. Largely through his influence it was soon put into practice in continental Europe.

The technique as performed in 1905 was briefly as follows. The animal was cast or placed upon the operating table and anæsthetized. He was then placed in dorsal position with the head completely extended upon the neck. After ordinary precautions in shaving and disinfecting the operative area, a longitudinal cutaneous incision was made on the median line, extending from the level of the anterior border of the thyroid cartilage backward over one or two tracheal rings. The incision was carried down to and exposed the thyroid cartilage, the crico-thyroidean ligament, the cricoid cartilage, and one or more tracheal rings. Then an incision was made through the crico-thyroidean ligament and cricoid cartilage, and sometimes through the first tracheal ring. Retractors were inserted in the wound and the margins held well apart, affording abundant room. The mucosa of the ventricle was grasped at the ventricular border by means of forceps, incised, and carefully dissected away from the underlying tissues by means of the razor-shaped scalpel of Moeller. Tracheotomy was generally performed as a safeguard against strangling during the first few days after the operation. The animal was then allowed to recover from the anæsthesia. The invading and ventricular wounds were disinfected daily for a few days.

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[1] *Annual Reports Am. Vet. Med. Assoc.*, 1906, 1907.

The operation met with far greater success than had followed any previous technique, but naturally had numerous defects. These were carefully studied and attempts made to eliminate them. In this work I was ably assisted by my colleague and assistant, J. N. Frost. One of the first defects to become prominent was chondritis and collapse of the tracheal rings due to the tracheotomy. It seemed impossible to sever the tracheal rings and insert the tracheotomy tube without encountering this danger. Two methods for overcoming this danger were devised. The flat trachea tube of M'Cully, which can be inserted between two tracheal rings without necessarily wounding either of them, offered a convenient method for avoiding the danger. It is not perfect, however, and inevitably leaves a scar, which may be detected upon examination. The other method is the laryngeal tube, which is inserted through the crico-thyroidean space—that is, through the invading incision for the operation—and does not involve any additional danger to the cartilages.

A similar defect in the operation was encountered in severing the cricoid cartilage. Like the tracheal ring it also became diseased occasionally, became thickened or collapsed, and ruined the animal. In an effort to overcome this, for a time, I severed the thyroid cartilage instead, either with a heavy scalpel or with a saw. The danger was not lessened. Again there was chondritis. The thyroid cartilage is so rigid that it does not collapse, but in some cases it becomes enormously thickened and extensively ossified, and in one instance caries set in. Finally it was found that the operation could be performed through the crico-thyroidean ligament without wounding the cartilage, and that through this wound the laryngeal tube could be inserted to guard against post-operative strangling.

The method of removing the mucosa from the ventricle has been subjected to extensive modification. Some operators still adhere to the original method of 1905. Other operators, after making the penetrant incision through the mucosa, insert the index finger through the incision and detach the mucosa with the finger-tip. In this way they obviate in a large measure the hæmorrhage ordinarily ensuing when the scalpel is used. Even with the scalpel, however, the hæmorrhage was not great. Later there was introduced, by Blattenberg, the ventricular burr—a spherical steel burr similar to that used by the human surgeon in the mastoid operation. This instrument was inserted into the ventricle, pushed against its bottom, and revolved until the mucosa was caught and entangled in the burr. By revolving the burr the mucosa was torn away from the underlying tissues. The detachment was completed by exerting traction upon the instrument, drawing the mucosa out of the ventricle, and everting it. The mucosa was then excised at the margin of the ventricle and removed.

It was soon found that the steel burr was quite dangerous, because it tended to mutilate the mucosa, penetrate it, and wound the perichondrium of the thyroid or arytenoid cartilage. From these wounds there arose perichondritis, with consequent thickening and the failure of the operation. Other operators advocated the use of a pair of forceps with the jaws roughened or milled on their exterior. The instrument was introduced into the ventricle, opened, and pushed against the bottom, after which it was closed, engaging a portion of the mucosa between the jaws. Then the instrument was revolved upon its long axis in the same way as the Blattenberg burr, and with the aid of traction the mucosa was everted. The forceps have in a large measure the same danger as the steel burr of Blattenberg: they may wound the adjacent perichondrium, thereby inviting failure of the operation.

Very early in the history of the operation, O'Connor of Dublin, and later M'Killip of Chicago, attempted to destroy the mucosa by cauterization. The attempt was unsuccessful.

After a thorough trial of the Blattenberg burr, with some very unfortunate results, I finally designed the soft rubber burr (Fig. 287). The naked burr would not promptly and effectively grasp the mucosa, but by wrapping a small piece of dry cheese-cloth or gauze about the rubber sphere and wiping the ventricle reasonably with surgeon's cotton, the mucosa could almost always be grasped firmly and securely at the first turn. Consequently the soft rubber burr was adopted as the safest and most efficient plan for denuding the ventricle of its mucosa.

The hyaline cartilages of the trachea and larynx are, one and all, exceedingly intolerant of any surgical interference which involves an open wound with subsequent infection. Consequently it has been the aim, from the very first, to avoid any injury to any cartilage. This is regarded as the most essential fundamental precaution in the operation.

A second question in the technique of the operation is the extent to which the denudation of the ventricle should be carried. The aim of the operation is the complete obliteration of the laryngeal ventricle, reliably inducing firm adhesion between the lateral surface of the arytenoid cartilage, the vocal cord, and the median surface of the thyroid cartilage, so that the arytenoid cartilage and vocal cord can no longer be forced out into the glottis to interfere with the air-stream during inspiration. If the mucosa of the ventricle is only partially removed the adhesion between the cartilage and vocal cord will be only partial, so that the arytenoid cartilage and vocal cord may drop into the glottis to some degree and interfere with respiration. At first I removed a considerable portion of the vocal cord. This, however, left the arytenoid cartilage somewhat dangling and tended to cause it to drop into the glottis and become fixed in a false position, partially occluding the glottis. Researches thus far indicate that the most favourable degree of denudation consists of the complete removal of the ventricular mucosa to its outermost margin, as indicated by the dotted line in Fig. 288, without removing any essential part of the vocal cord. Inevitably the operation involves the removal of the mucosa from the lateral surface of the vocal cord, but when completed the vocal cord still remains intact and the denuded ventricle remains as deep as before the operation, plus the depth of the tissues removed. The ideal in the operation is so to remove the mucosa that when the healing is completed the arytenoid cartilage and the vocal cord are firmly adherent in the positions shown in Fig. 289.

The confinement and control of the patient have also undergone far-reaching evolution. As previously stated, at first the horse was cast or placed upon the operating table, anæsthetized, and then placed in dorsal position. Inevitably casting accidents occur, as they must in any operation. Of still greater importance were the dangers from anæsthesia. There were the ever-present primary dangers of asphyxia and syncope and the secondary dangers of chloroform, pneumonia, and hepatic degeneration. Furthermore, following the struggles and the anæsthesia, there was inevitably a greater amount of hæmorrhage and the wounds did not heal so promptly.

After it had been clearly demonstrated that the operation could be performed through the crico-thyroidean ligament, and also that the mucosa could be securely and safely grasped and everted by means of the soft rubber ventricular burr, my colleague Frost and I began operating exclusively upon the standing animal. Local anæsthesia was necessarily substituted for general. It has been found that the operation is far more easily and quickly performed upon the standing animal. The patient is spared the physical strain of casting and the dangers of anæsthesia. The hæmorrhage is decreased fully 90 per cent. The operation has been transferred, so far as the pain, the mutilation, and the dangers are concerned, from a major to a minor operation. At first it was assumed that only a few of the more stoical patients could be operated upon in the standing position, but a brief experience showed that almost, if not all animals can readily be operated upon standing.

In order to facilitate the operation upon the standing patient, it was essential that a convenient form of laryngeal speculum be devised, such as that shown in Fig. 286. It is quite securely self-retaining in the standing animal, dilates the penetrating wound very effectually, and affords good opportunity for illumination of the interior of the larynx.

While the operation upon the standing patient with the removal of the ventricular mucosa by means of the soft rubber burr is decidedly the preferable method, there are nevertheless many good operators who prefer some other plan. The following technique will answer as a general outline for the operation, and may be modified by the individual operator to suit his preferences, so long as the fundamentals are retained.

Those who prefer to operate upon the recumbent patient may secure him either upon the operating table or by casting, and may operate under either general or local anæsthesia. Local anæsthesia is never perfect in the recumbent animal, because he constantly resists the confinement, however devoid the operation may be of pain. After local or general anæsthesia has been obtained, the animal should be placed and retained in the dorsal position. Generally, operators have preferred to maintain the dorsal position by packing bundles of straw against the sides of the horse and by having one or more assistants hold the horse from either side. A better and easier way, which more thoroughly avoids the possibility of the horse's overcoming the restraint applied and turning upon his side, thus suspending the operation, is by means of pulleys attached to a beam above and to the feet or legs of the patient below. By this means the dorsal position may be securely maintained for any length of time. It has the further advantage of partially suspending the horse, so that there is not the same danger of contusion of the withers or other portions of the body.

The instruments and materials required for the operation are a razor, two or three scalpels, three pairs of Pean's 9-inch curved compression forceps, scissors, laryngeal speculum, reflecting electric lamp, two soft rubber ventricular burrs with a few pieces of cheese-cloth or gauze about three inches square for covering the rubber sphere, needles and thread, surgeon's cotton, and a laryngeal tube.

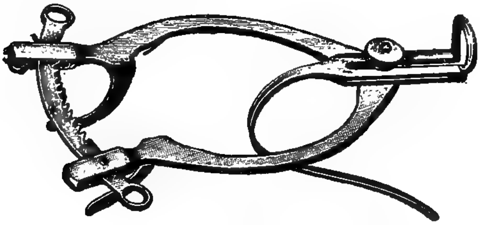


Fig. 286.—Laryngeal speculum.

If the operation is undertaken out of doors in sunshine, the animal should be secured with his head away from the sun, so that the rays of light, coming from above and behind the animal, enter the larynx obliquely downward and forward, illuminating the field of operation. If the patient is secured with his head toward the sun, the interior of the larynx is in shadow and the light blinds the operator. If the operation is performed indoors by means of daylight through a window, the patient is to be secured with his head pointing away from the window. Upon a dark day or in a dark room the larynx may be splendidly illuminated with an ordinary reflecting electric lamp upon an extension cord, or, if electricity is not at hand, with the ordinary pocket electric light. The operation may be performed in a dark room at night with the aid of the reflecting electric lamp.

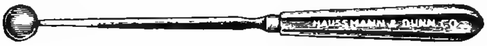


Fig. 287.—Soft rubber burr.

When local or general anæsthesia has been satisfactorily attained, the patient secured in the dorsal position, and provision has been made for the illumination of the interior of the larynx, the operation proceeds in the same manner as in the standing operation.

Suitable stocks afford the most convenient and efficient method for securing the patient for the standing operation, but they are not necessary. The essentials are that the patient cannot pull backward or suddenly forge forward, that he can be prevented from rearing or striking, and that provision shall be at hand for securely elevating and extending his head. Backing the horse into a narrow single stall suffices as a general rule. Rearing may be prevented by passing a rope or strap over the withers and securing the ends below to the stocks, stall partition, or floor. Striking may be prevented by a rope or strap crossed in front of the upper end of the radii and secured to a post on either side. The head may be securely elevated by passing a strap or a cord over a beam or through a ring or pulley above, one end of which is securely fastened to the noseband of the halter and the other held by an assistant. The head should not be elevated by means of the halter shank with its usual attachment, because that tends to rotate the head and distort the operative field. It is necessary, also, that the halter shall be devoid of a throat latch, or have one which can be detached and pushed aside, leaving the ventral surface of the head and neck fully exposed. Tact and patience should be exercised, in order that the patient shall not unduly feel the confinement. The head should be elevated carefully and gradually, and the entire confinement should be carried out very gently. As soon as the head is properly elevated and the patient has ceased to resist, the operative area should be carefully shaved and disinfected.

Local anæsthesia is to be induced by cocaine and adrenalin, or other local anæsthetic, should the operator prefer. The cocaine-adrenalin solution should be injected subcutaneously, accurately upon the median raphe, over the entire length of the future cutaneous incision. When inserting the hypodermic needle the operator should bear in mind the fact that directly upon the median raphe of the neck there are very few nerve endings, and that consequently the patient will not resist the introduction of the needle at this point nearly as much as he will if the operator carelessly attempts to introduce it the merest trifle to the right or left of the median line. Ordinarily, the most nervous patient will readily stand for the subcutaneous injection without the application of the twitch or other painful or powerful restraint. Such restraint should be avoided as long as possible, as many horses, especially those which are nervous, will resent the application of the twitch far more than the introduction of the hypodermic needle. Upon most horses the entire operation may be carried out without the use of the twitch or other painful or powerful method of control.

After the application of the local anæsthetic has been completed, the patient's head should be freed, and ample time given for the thorough development of the anæsthesia. After ten minutes or more, the skin over the operative area may be cautiously pricked, in order to determine whether the anæsthesia is satisfactory. If not complete, further time should be given, and if necessary an additional application of the local anæsthetic should be made.

When the local anæsthesia is complete, the patient's head should again be elevated and the cutaneous incision made, extending from a point one or two inches in front of the anterior end of the thyroid cartilage downward and backward to the level of the first tracheal ring. The incision should be carried through the skin and fascia down to the cartilages of the larynx and trachea, without wounding the perichondrium. The operator should be careful to make the incision directly upon the median raphe, where the degree of sensation in the skin is very low and the cutaneous tissues are non-vascular. Ordinarily, only a few drops of blood escape from the cutaneous wound. Usually it is necessary merely to mop the blood away with sterile cotton or gauze. In case of necessity, the forceps should be applied to any vessels of recognizable size.

The operator should next definitely recognize by palpation the outlines of the crico-thyroidean ligament. Care must be exercised in this, or the operator may fall into error. The crico-thyroidean ligament is triangular, with a rounded apex ; its base rests against the cricoid cartilage and its apex against the notch in the thyroid cartilage. When the head is completely extended for the operation, the cricoid cartilage is drawn away from the first tracheal ring for a distance, and the intervening ligament may be mistaken for the crico-thyroidean ligament, but it is not triangular like the latter, and there should be no difficulty in differentiating between them if care is taken. Should error arise and an incision be made through the ligament between the cricoid and first tracheal ring, no harm is done except the delay and embarrassment.

Having fully identified the crico-thyroidean ligament, the operator should place a narrow-bladed scalpel with its back resting against the anterior border of the cricoid cartilage, as accurately upon the median line as possible, with its point directed upward and backward so that, when it passed through the crico-thyroidean ligament, the point will project behind the arytenoid cartilages. If directed perpendicular to the long axis of the larynx, the scalpel may wound the paralyzed arytenoid cartilage or pass between it and the thyroid cartilage. After the scalpel has safely penetrated the crico-thyroidean ligament the incision should be carried forward on the median line to the thyroid cartilage. Care should be taken not to wound the thyroid cartilage. The laryngeal speculum (Fig. 286) is then to be placed in position, as indicated in Fig. 290.

In inserting the laryngeal speculum the sliding hook is detached, the jaws of the body of the instrument are closed, and the curved spurs are inserted through the incision in the ligament and pushed backward within the cricoid cartilage. The jaws are then spread apart as widely as practicable, after which the slotted hook is inserted. The distal end of the hook is engaged within the thyroid cartilage. The hook is then pushed as far forward within the thyroid cartilage as possible, and secured.

When the speculum has been properly applied and secured in position, the operator may observe the conditions within the larynx and verify his diagnosis. The larynx should be thoroughly illuminated by means of a reflecting electric lamp, so that every part of the organ may be observed. In many cases the arytenoid cartilages and vocal cords move but little during respiration through the dilated incision, and it is difficult to determine the exact condition. If the operator will insert a long pair of forceps, or other instrument, forward through the incision and glottis against the base of the tongue, the animal will at once swallow, and in so doing will close the glottis. It can then be seen whether the two arytenoid cartilages move properly. If the two cartilages move vigorously and alike, the difficulty is not paralysis of the recurrent nerves, but the roaring is due to some other cause. Removing the mucosa from the lateral ventricles is unwarranted in such cases. If the pre-operative diagnosis of roaring is verified by the direct inspection of the opened larynx, the operator should proceed to induce anæsthesia of the interior of the larynx and of the ventricular mucosa. This is best done by grasping with the Pean's forceps a small pledget of surgeon's cotton saturated with the cocaine-adrenalin solution, carefully painting the solution over the interior of the larynx, and then inserting the cotton within the ventricle. The process should be continued until complete anæsthesia is obtained. If this is not done, the animal is liable, because of the pain inflicted, to jerk the head suddenly at some critical point in the operation, interfering seriously with success.

Should the surgeon prefer to operate upon the recumbent patient, and has used general anæsthesia, the speculum should be applied and other details of technique carried out the same as for the standing operation. If the operator prefers not to use the ventricular burr, he should, after the speculum has been securely applied, grasp the mucosa of the ventricle at its margin with the forceps and exert traction upon them while he penetrates the mucosa on the side of the forceps opposite to the ventricular cavity. The incision is to be carried more or less completely around the margin of the ventricle, after which the mucosa is to be carefully dissected away, either with the scalpel, with a closed blunt pair of scissors, or with the index finger.

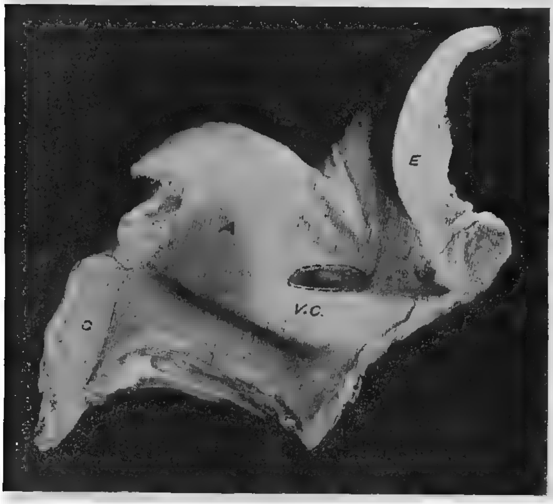


FIG. 288.—Photograph of left half of larynx with dotted line at margin of laryngeal ventricle indicating point advised for the excision of the mucosa.

E, epiglottis; *A*, arytenoid cartilage; *V.C.* vocal cord; *C*, cricoid cartilage.

The removal of the ventricular mucosa in the standing operation is best accomplished with the soft rubber burr. When the local anæsthesia of the laryngeal mucosa is complete, the operator should wipe away any mucus or saliva, either in or about the ventricle, by means of absorbent cotton applied with forceps. The soft rubber burr, about which there has been wound a small piece of dry cheese-cloth or gauze, is then carefully inserted into the ventricle and pushed firmly against its bottom. The burr is then revolved to the right (the burr is ordinarily fastened on the handle by revolving the handle to the right, and becomes unscrewed if turned to the left) upon its long axis, pressing gently upon the handle until the burr grasps the mucosa, as indicated by the resistance. As soon as the operator feels that the mucosa is securely engaged, the burr should be given one-half to one complete additional turn, after which traction is exerted, instead of pushing upon the burr. The rotation upon its long axis is continued to some extent during the application of the traction, which tears the mucosa loose from the subjacent tissues. Continued slight rotation of the burr ensures its grasp upon the mucosa. The traction is increased, and finally the ventricular mucosa is drawn out inverted through the mouth of the ventricle. Just as the burr is emerging from the mouth of the ventricle there is a tendency for the mucosa to slip away. In order to avoid this, it is best to press the handle of the burr outwards—that is, lateralwards and upwards—so that the soft rubber burr is forced downwards and inwards against and beyond the vocal cords. At this point the everted mucous sac should be grasped with the forceps between the burr and the vocal cords. The forceps should then be closed upon the sac and the rubber burr released by revolving it in the opposite direction—to the left. A second pair of forceps should now be placed above the first pair, in order to get a more secure hold. Traction is then applied upon the sac, and the inverted mucosa is punctured with a scalpel at the ventricular border along the vocal cord. The incision is extended around the border of the ventricular mouth, either with the razor-shaped scalpel, an ordinary straight scalpel, or blunt curved scissors, as the operator may prefer. The ventricular mucosa when perfectly removed should constitute a closed sac, which may be pressed over the operator's thumb in order to determine whether the removal is complete.

Should the mucosa, when it is being everted, accidentally slip from the burr, it is not always easy to grasp again, because some hæmorrhage may occur inside the ventricle or mucus may be thrown out in large quantity, causing the burr to slip. In such case the forceps may be introduced into the ventricle, the jaws opened, pressed against the bottom of the sac, and closed, thus engaging a portion of the sac. Traction is then exerted upon the forceps and the mucosa is everted. As soon as the everted portion appears at the mouth of the ventricle, it should be grasped above the first forceps with the second pair, and a more secure hold

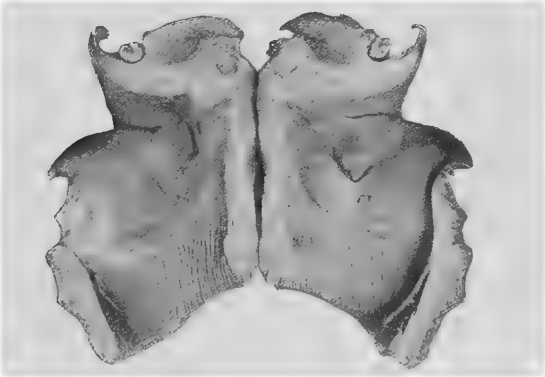


FIG. 289.—Sagittal division of larynx twenty-one days after removal of the mucosa from the left ventricle.

upon a larger part of the mucosa obtained. Traction is then applied upon the second pair of forceps, and the division of the mucosa about the margins of the ventricular mouth is carried on the same as described with the burr.

When the mucosa has been completely removed the denuded tissues in the ventricle may be mopped over with a reliable antiseptic, such as tincture of iodine.

Formerly it was advised to operate only upon the left side of the larynx. More recently it has been found advisable, in the experience of most operators, to include both ventricles, as a rule of practice. Although the paralysis causing roaring is commonly more severe on the left side, it has now come to be understood that in most cases there is a minor degree of paralysis upon the right side also. The paralysis upon the left side is usually so much more marked than that upon the right that it has been erroneously concluded that the disease exists only upon the left side. In many cases of roaring, both nerves are badly involved and little difference can be seen in the tone of the muscles of the right and the left sides. In the clearly bilateral laryngeal paralysis the question of whether one or both ventricles should be operated upon is not open to discussion. As a general rule of practice, in a recent case of roaring it would appear to be best by far to operate upon both ventricles simultaneously. No material harm is to come from the bilateral operation; the danger therefrom is not materially greater than from the unilateral operation; and, once the horse has recovered, he is none the worse for having both ventricles destroyed. When the operation succeeds, the only change wrought in the larynx is in the vocal apparatus. Whenever roaring becomes pronounced, the horse is virtually mute because of the paralysis, even if only one side is involved. When the bilateral operation for roaring is performed, the patient becomes permanently mute. Since the loss of the voice is of no consequence ordinarily, this factor may, as a rule, be wholly ignored.

Should one prefer to operate upon the left side only and the operation fails because of paralysis on the right side, the operation may of course be readily repeated. If the roaring is of long standing and the right arytenoid cartilage and vocal cord appear to be normal, it is reasonably safe to risk the unilateral operation. In a recent case of roaring, even though the right side appears to be normal, the operator must constantly face the risk of advancing paralysis of the right cartilage, not evident at the time of the operation, but which may develop at a later date and raise a question of the surgeon's prudence in operating upon one side only.

When the removal of the mucosa from the ventricle or ventricles has been completed, the larynx should be wiped free from blood and mucus, the laryngeal speculum removed, and the laryngeal tube inserted. Generally it is best to secure the laryngeal tube in its position by means of sutures in the margins of the cutaneous wound, in addition to tapes tied over the poll. The patient is then to be released and reasonably close watch kept during the following forty-eight hours. The laryngeal tube should be removed and cleansed after twenty-four hours. At the end of forty-eight hours the laryngeal tube should be removed and the wound dressed antiseptically. If the respiration is normal, the tube may be omitted. The invading and corrective wounds may be dressed antiseptically once a day for a few days, after which only the exterior or invading wound should be disturbed.

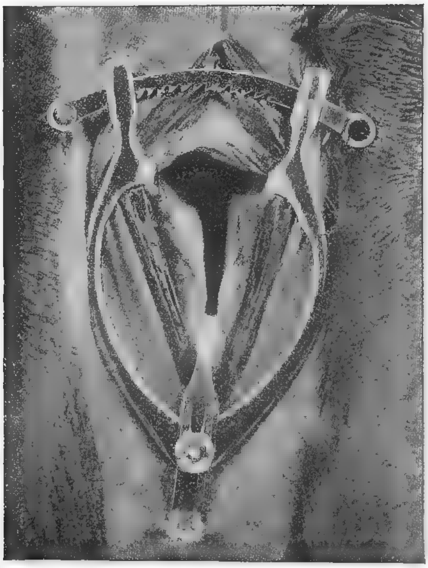


FIG. 290.—Laryngeal speculum applied.

There is little special care to be taken with reference to feeding, either before or after the operation, except when the patient is cast and anæsthetized. The horse may be allowed an ordinary ration suitable to an animal at rest. He should be kept quiet in a box-stall for ten to fifteen days, and may then be allowed to run in a paddock or may take light exercise to the halter. For some time after the operation the horse should not wear a halter with a throat-latch. The throat-latch becomes soiled with the discharges and serves to retain them against or in close proximity to the wound. It is best to remove the halter or other headgear entirely.

Ordinarily the wounds heal in about twenty days. The animal may then have moderate exercise, and in four to six weeks may be placed at gentle work. When first tested, the animal may breathe imperfectly, owing to excessive granulation tissue in the ventricle pushing the cartilage and vocal cords into the glottis. Many such cases improve after a time. In some cases the improvement gradually increases for six months or a year after the operation.

Ordinarily the prognosis for the operation is good. Horses desired for racing purposes, which are put to extreme test, do not recover so satisfactorily as ordinary work-horses. In racing horses, approximately 50 per cent recover completely, so that they may race without unnatural breathing. In hunters, which are exerted less severely, the percentage of recoveries is decidedly higher. In horses used for ordinary work the recoveries reach approximately 80 per cent. The animals which do not recover completely are nearly all materially improved. The failures are largely dependent upon chondritis due to injury to the perichondrium in the course of the operation or to errors in the extent of denudation of the ventricle. The technique, as here given, is designed to avoid any and every injury to the cartilaginous tissues. The more careful the operator is in avoiding these injuries, the higher will be the percentage of recoveries. Whenever the cartilage is injured it tends to become infected and inflamed, followed by chronic thickening, and frequently by limited necrosis surrounded by granulation tumours, which serve to occlude the glottis or trachea. When these growths occur, they are not ordinarily subject to surgical remedy. They may be removed readily enough, but the necrosis continues and the tumour-like masses again develop. Therefore it is highly important that the injuries to the cartilages shall be prevented.

W. L. W.

TRACHEOTOMY

By the operation of tracheotomy one understands, not only incision of the trachea, but the fixation into it of some appliance through which a free passage of air is obtainable.

Tracheotomy is performed to facilitate respiration when this is seriously impeded by the existence of any abnormal condition in the air passages above the usual seat of operation. Tracheotomy is undertaken both as a temporary and as a permanent measure. It is performed as a temporary measure for the relief of dyspnœa resulting from obstruction due to some acute pathological condition of the larynx or upper air passages, or when necessary to enable the performance of an operation involving any part of these. It may also be performed to enable the carrying out of the necessary correction in malpresentation occurring in difficult parturition, if the straining of the parent is so severe that this cannot otherwise be accomplished: by nullifying the closure of the glottis the extra pressure to be obtained by fixation of the diaphragm with the lungs fully distended is unobtainable.

The operation is performed as a permanent measure when chronic obstruction to the free passage of air exists; in a few cases in which the obstruction continuously impedes respiration, but in a majority of cases in which respiration is impeded only during exertion.

Although the operation is performed as a temporary measure on the majority of the domestic animals, it is much more frequently performed upon the horse than on any other; and it is almost solely upon this animal that it is undertaken as a permanent measure. The operation upon the horse will be described, and although the operation upon other animals is rendered slightly more difficult owing to the less prominently situated trachea, it is precisely similar in surgical respects.

Since the part of the trachea involved in the operation—the upper third—is readily exposed without mutilation of any vitally important tissue, a detailed description of the anatomical structure other than that mentioned in describing the operation itself is unnecessary.

The choice of the exact place in the upper third of the trachea at which to insert the tube depends upon varying circumstances: the existence of disease, conformation, and whether the operation is performed as a temporary or as a permanent measure.

In urgent cases it may be necessary to perform the operation comparatively low down the trachea, either on account of œdema or cellulitis about the larynx and upper part of the trachea, or if dyspnœa is very marked. In the latter case it is inadvisable to attempt to raise the head, for any slight disturbance may be sufficient to so aggravate the difficulty in respiration as to cause the animal to stagger or fall and be a danger to the operator. Such cases leave little choice to the surgeon in regard to instruments, technique, or position, the necessity for immediate relief far outweighing all other considerations.

A general rule to be observed in tracheotomy is that it shall be performed as high up the trachea as possible. The observance of this rule is more important when the operation is performed to insert a tube for permanent use. The most suitable position is at about the third, fourth and fifth tracheal rings, and in some cases it may be performed at even the second and third rings. In horses of the heavier breeds having short thick necks and little or no curvature between the submaxillary space and the front upper portion of the neck, it is not possible to place the tube quite so high.

There is no disadvantage in this high position. There are many reasons for adopting it. The longer course the air has to traverse on its way to the lungs is advantageous; the tube having a more downward than forward direction, the entrance of foreign bodies into the trachea during locomotion is less likely, *e.g.* dirt and other material thrown up by a horse in front while galloping; the tube is less likely to become caught or hung up, and injury to the trachea result, such as might happen by the tube becoming fixed on a manger, rail or rope; and if after a time excessive granulations or any other trouble should become so severe as to render impossible the maintenance of the tube at its original position, the operation can be repeated lower down.

Instruments.—Tracheotomy tubes of various patterns have been devised. The simplest is a curved metal tube having at one end a wide oval flange, at the opposite extremities of which are cut two slots from which tape fastened round the neck holds the tube in position. The latest pattern tube is made in several pieces, which when adjusted in position render it self-retaining. This latter type of tube is invariably used when a tube is required for a permanency, and although the former type of tube—slightly varied in pattern, the tube part being flattened or elliptical in cross-section—is still used in some cases in which a tube is required temporarily, one of the simpler self-retaining tubes is just as or even more satisfactory. Occasionally, however, the operation has to be performed in such urgent circumstances that no tube of any pattern is at hand. The contrivance of some means whereby the incision into the trachea may be maintained patent until a proper tube can be obtained and inserted is left to the ingenuity of the operator, but in case of emergency a tea- or coffee-pot spout, or a piece of strong wire suitably bent, may be employed for this purpose.

The essential points of a tracheotomy tube are: that it is made of some metal that does not corrode; that it is strong and large enough to admit a sufficient supply of air, but not too heavy or cumbersome; that it is readily cleaned; that it is easily inserted; and that it is secure and firm when placed in position. The most essential feature of a tube for permanent wear is that it fits exactly the opening into the trachea after the primary inflammatory swelling has subsided, both as regards the length from the skin to the inside of the trachea, and as regards the coming into contact with every part of this passage. Jones's tracheotomy tube (Fig. 291) is constructed on lines that enable it to meet these requirements. Arnold's improved Nelson (Fig. 292) is a similar tube. These tubes are of very similar pattern, and are the most suitable for permanent wear. They are made in various lengths and diameters. Each tube consists of four pieces: parts 1 and 2 are flanged, and are inserted, one at the bottom of the opening into the trachea and one at the top of it; part 3 is placed between parts 1 and 2, and when pushed home renders the tube securely held by keeping the flanged portions apart. This third piece has a projection at each side of its inner extremity. These projections prevent the ends of the divided tracheal ring from overlapping the inner opening of the tube and curling into the lumen of the trachea. Part 4 is a plug for the external opening of the tube. It should be maintained in position except when the animal is at exercise or work. Gibson's tube is similar in structure to the two already named, but has in addition a valvular arrangement in the

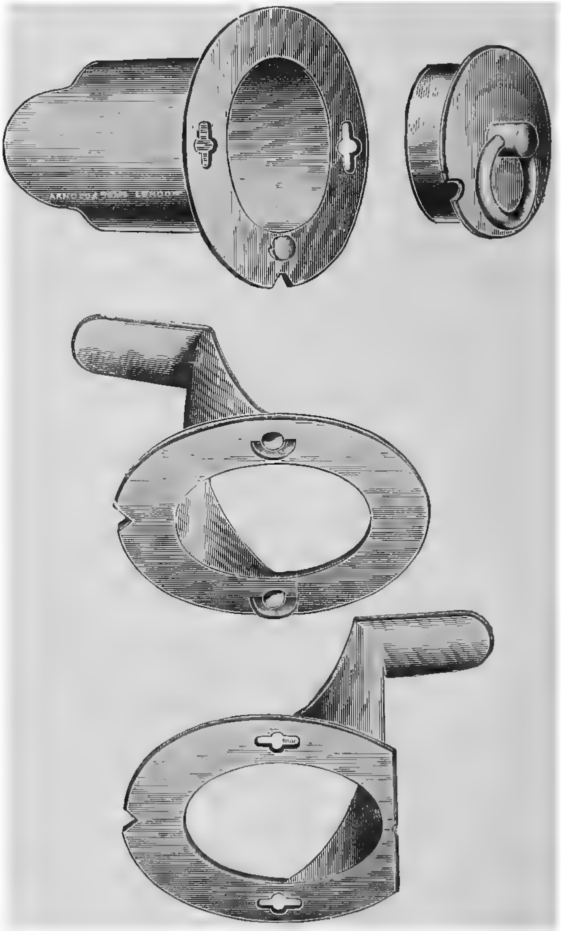


Fig. 291.—Jones's tracheotomy tube.

lumen of the central or third piece. The valve, which consists of two semicircular metal leaves, opens inwards, allowing for inspiration by the tube. The valve closes on expiration, in which, as a result, the air escapes by the natural passages.

For temporary use, a Field's pattern tube (Fig. 293) is quite suitable. This tube is made in two pieces, similar in structure and consisting of a wide flat oval flange, from the centre of which passes backwards a short round tube which has a half-round long curved lip. The curved lip and tube of part 2 pass through part 1 so that the flanges lie directly super-imposed to each other, and the lips curve in opposite directions. The two pieces are held together by a movable clasp on part 1. This is not a suitable tube for permanent wear, because, owing to the divergence of the two lips, and the otherwise loose fitting of the tube, granulation tissue forms, and soon bulges into the lumen of the tube. For temporary use, however, this tube is quite satisfactory.

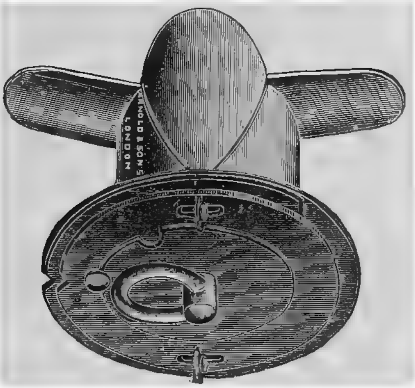


FIG. 292.—Arnold's improved Nelson tube.

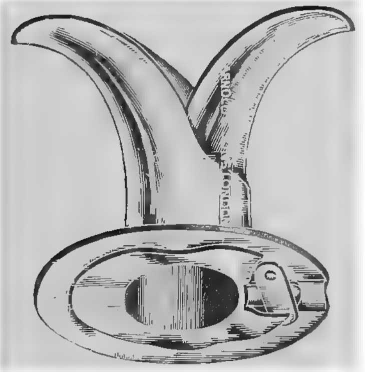


FIG. 293.—Field's tracheotomy tube.

A little difficulty is often experienced in inserting a temporary tracheotomy tube when the opening into the trachea has been made by simple longitudinal incision through one or more of the tracheal rings. If a Field's tube, or one of similar pattern, is being used this difficulty can be obviated by holding the part being first inserted sideways so that the lip of the tube can be directed lengthwise through the incision; then by giving the tube an inward and downward twist it assumes its proper position. The remaining part is inserted similarly, but with an inward and upward twist.

Various tracheotomes have been devised for removing the portion of the trachea in order to accommodate the tube.

Spooner's tracheotome (Fig. 294) is an instrument similar in form and in application to a pair of ordinary compasses, the extremity of one arm being in the form of a scalpel. The arms have an adjustable screw by which the instrument is set to cut a circular piece of the required size from the trachea.

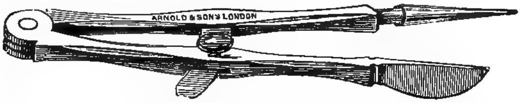


FIG. 294.—Spooner's tracheotome.

M'Kenny's tracheotome is a very much heavier instrument. It has a hinged disc-shaped knife, which by means of a thumbscrew working on a threaded spindle is protrusible from and retractable into a circular "wad-cutter" shaped knife. The disc-knife is passed transversely between two of the tracheal rings into the lumen of the trachea. On tightening up the screw the disc-knife, which has assumed a position at right angles to its spindle, is drawn within the circular knife, completely severing a piece of the trachea.

If it were necessary, or in any way advisable, that the opening into the trachea should be a precise geometrical shape, then, regardless of their disadvantages, the use of such instruments would be justified. There is, however, no necessity for the opening to be exactly circular. More freedom of judgment as to the exact portion and amount of the tracheal rings to be removed is possible by using a knife guided by hand than by using a fixed mechanical cutter. And further, since the operation is not performed under a general anæsthetic there is always a chance—a probability rather—that the animal will prove restive just when the instrument is fixed in position and the cutting incomplete. Serious injury might result, especially if the instrument is at all cumbersome or heavy. A really serviceable retractor is much more conducive to the neatness and ease with which the operation can be performed. Fig. 295 illustrates one used by the writer, and Fig. 296 shows it in position. The hooks are fixed on to the ends of a buckled strap which passes round the animal's neck. The retractor can thus be adjusted to any sized neck, and by reason of pieces of strong elastic, interposed between the hooks and the ends of the strap, an even pressure is maintained during any movement of the animal's neck.

Other instruments required are: a scalpel, a probe-pointed bistoury, a tenaculum hook, having a barb on it like that of a fish-hook, or in place of the latter a pair of vulsellum forceps, dissecting forceps, scissors, and several pairs of artery forceps.

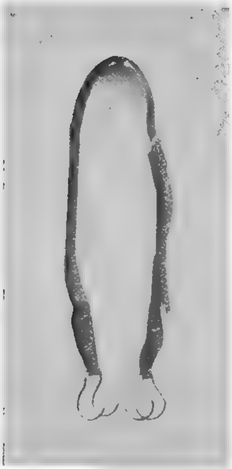


Fig. 295.—Retractor.

All instruments, including the tube, should be sterilized before being used.

Preparation.—The hair on the front upper third tracheal region should be clipped short and the skin of this area painted with tincture of iodine. A combined local anæsthetic and hæmostatic is then injected subcutaneously and submuscularly at the exact seat chosen for the operation, and a suitable time allowed for anæsthesia to be produced. During this time an area of skin some 15 cm. long by 10 cm. wide over the seat of the operation may be shaved and redisinfected. Shaving, however, is by no means necessary, provided the hair is cut short and the area well disinfected.

Operation.—The operation should be carried out under strict aseptic conditions when possible, and upon the animal in a standing position. The head is raised slightly, just sufficiently to allow the operator to gain access to the trachea. The head should not be raised excessively, because this not only tends to upset the animal, but by considerably altering the relative positions of the trachea and the overlying skin, will cause some puckering of the latter when the head resumes its normal position. This puckering of the skin, even when the head is only slightly raised, is prevented by removing the lowest part of the exposed portion of the trachea. The animal should be backed into a corner where there is a beam over which a cord can be placed and used for raising the head in a similar manner to that followed in drenching. The cord should have a wide webbing loop at the end. This loop is threaded down inside the nose-band of the head-stall and placed under the lower jaw, not in the mouth. A sling made of a stable rubber can be used and the cord tied to this. If the animal's head is raised in this manner and not too high and a local anæsthetic used, no other form of restraint is as a rule necessary. A twitch in the majority of cases causes more annoyance than benefit.

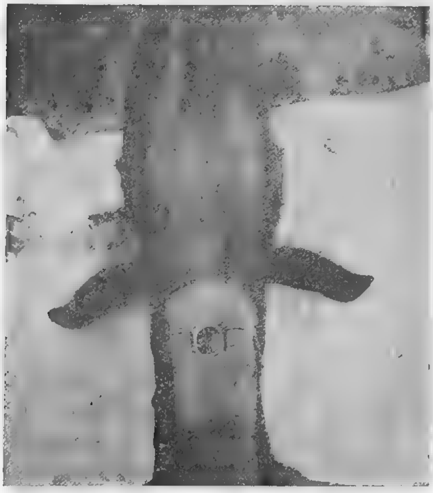


Fig. 296.—Retractor in position.

The skin is rendered tense over the seat of the operation by the thumb and fingers of the left hand, and an incision from 5 cm. to 6 cm. long made through it with the scalpel, the direction of the incision being from above downwards. The subcutaneous connective tissue and the thin layer of the panniculus carnosus muscle are then divided, thus laying bare the muscular tissue. The retractor is now adjusted to the lips of the skin wound, and with such tension that a more or less square opening will be presented. Any remaining connective tissue overlying the muscles is easily and quickly removed. This removal of the loose connective tissue so as to lay quite bare the underlying muscles, and a clear understanding of the anatomical relationship of the latter, are necessary to avoid injury and to ensure that the tube will occupy a mesial position when the operation is completed.

The muscles exposed are the right and left hyoid portions of the sterno-thyro-hyoideus muscles, and the right and left subscapulo-hyoideus muscles. The former occupy the middle position, and are in intimate apposition to one another, the line of demarcation between the two being very indistinct. The latter occupy a lateral position, the right and left muscles do not come together in the middle line, but they are closely applied to the external side of the first-mentioned muscles, the lines of demarcation being slight but distinct. Division along one or other of these lines is often practised in mistake for its being the middle line; this causes the tube to take a slight tilt to one or other side. If the line of apposition of the muscles cannot be made out, separation of the muscular fibres along a line equidistant from the lateral lines referred to is made, care being taken to avoid cutting the muscle fibres unnecessarily. Separation is continued till the trachea is exposed, and is extended a little further than the lower limit of the skin incision. The separated muscles are now included in the retractor, and the inner free edges of two underlying muscles come into view. These muscles are freed from the trachea and included in the retractor; and any loose connective tissue immediately overlying the exposed portion of the trachea is dissected away.

Procedure now varies somewhat according to whether the operation is for a temporary or a permanent purpose. If temporary, the trachea is incised only; usually a mesial longitudinal incision is made through one or more rings and the tube inserted; or if a tube, flatly elliptical on section, is to hand, it may be inserted through a transverse incision in one of the inter-annular ligaments. If the operation is for a permanent measure, then part of the trachea is removed.

When a portion of the trachea has been excised there is a tendency to collapse of that part of it containing the mutilated rings. This tendency to collapse is in great part due to the normal incompleteness posteriorly of the tracheal rings, and though of no consequence as long as a well-fitting tube is in position, it may lead to serious trouble if a small ill-fitting tube is used, or if it is desired to remove the tube and allow the opening to close. Various opinions have been expressed as to the precise amount of the tracheal rings that should be removed in order to prevent or minimize this result. The amount removed depends necessarily upon the size of the tube that is inserted, and also upon the width of the tracheal rings, which varies in different animals and even in the same animal. If a Field's tube is used the whole width of a portion of one ring, or a part of two rings and the intervening inter-annular ligament, will suffice; but if a tube of Arnold's improved Nelson or similar pattern is employed, then the complete width of one ring will be insufficient, and if parts of the width of two rings—at least two-thirds of the width of each will be necessary, to prevent undue pressure on them by the tube—are removed, these rings will be so weakened anteriorly that collapse and deformity will not be prevented. In the writer's experience the removal of the whole width of a portion of one ring is attended by the least serious results, provided the rings on each side of it are left sufficiently strong to maintain their normal shape. He therefore removes the whole width of a portion of one ring, the inter-annular ligaments on each side of it, and a part of the width—about one-third—of the ring next above and that next below. A slight disadvantage of this method is that the ends of the divided ring tend to catch on the inner projections of the third or central piece of the tube when it is being inserted. If, however, sufficient of the ring has been removed and the tube is carefully inserted for a day or two until these more or less free ends of the divided ring are healed over, no trouble will occur.

The removal of the portion of the trachea is carried out as follows: The scalpel is passed through the lowest visible inter-annular ligament, making a transverse incision about 2 cm. long. The barbed tenaculum is passed through this opening, given a quarter turn, and hooked through the middle of the tracheal ring next above. Vulsellum forceps may be used in place of the tenaculum, but they are not so handy for maintaining a continual hold on the piece of the trachea which is removed. Holding the tenaculum firmly, but lightly, with the left hand, the end of the probe-pointed bistoury is passed through the incision and the latter carried out to about 1·5 or 2 cm. from the mesial plane. The edge of the knife is then turned upwards and at right angles to its former position, and the tracheal ring above it cut through by a sawing motion—the cutting pressure being exerted when drawing on the knife rather than when pushing on it. The incision is carried on through the next inter-annular ligament and continued to the left in a curved direction, so that a segment is cut away from the next ring, the width of the segment at its middle part being a third the width of the whole ring. The edge of the bistoury is now from 1·5 to 2 cm. to the left of the middle line, and by cutting perpendicularly downwards the ring already severed on the right and the ligament below it are cut through; then by turning the edge of the knife to the right a portion of the next ring, similar to that removed from the top ring, is cut away, and the piece of trachea required to be removed is thus completely freed.

This cutting away of the piece of the trachea can be carried out in a clockwise or anti-clockwise direction, whichever suits the operator.

The retractor is removed and the tube at once placed in position and the animal's head lowered. The hæmorrhage, which is slight and almost solely from the cut mucous membrane lining the trachea, invariably causes a certain amount of coughing, and it is for this reason that the head should be lowered as soon as possible in order to enable any blood to be more freely expelled.

After-treatment.—During the first few days there is bound to be more or less swelling of the tissues surrounding the seat of operation. To allow for this swelling the tube inserted should be about 1 to 1·5 cm. longer than the thickness of the tissues from the skin to the inside of the trachea when the head is held in the normal position, otherwise the compression of the mucous membrane lining the trachea by the inside flanges of the tube may be so great as to cause necrosis of the membrane; and if this occurs, granulation of it will follow, which may be troublesome to deal with. The external flange may also exert a similar effect upon the skin, and in addition there may be some difficulty in replacing the tube when it has been removed for cleaning purposes.

The tube should be removed and cleaned daily for the first week or ten days. This cleaning must be done as expeditiously as possible, owing to the rapid contraction of the opening into the trachea when the tube is not in position. A second clean tube may be employed, so as to enable a more thorough cleaning and disinfecting of the used tube.

The removing and replacing of the tube should be done by some one who realizes the necessity of its being done carefully in order that no scratching of or injury to the tissues shall occur, and that the tube shall be correctly replaced. A mild antiseptic should be used for cleansing the wound, and any excess in granulation of it should be immediately controlled by light cauterizing; a 5 per cent solution of chloride of zinc answers admirably, but it must be applied cautiously, so that no excess of the fluid runs off the raw surfaces.

The greater part of the inflammatory swelling will have subsided in about ten days' time, and a tube should then be fitted to the exact requirements of the throat. This latter tube when once adjusted should not be removed more frequently than is necessary. It should be allowed to remain in position for increasingly longer periods, until it can be worn continuously for several months. The plug should be removed and any accumulated mucus cleared from the inside passages of the tube by means of a smooth spatula-like instrument, injury to the mucous membrane at the back of the trachea being avoided.

Excessive granulations of the mucous membrane and septic chondritis of the tracheal rings, the bugbears of tracheotomy, are more easily prevented and controlled by the exercise of special attention to the throat immediately following the operation, by the selection and fitting of a good pattern tube, and by not irritating the tissues by continual removal of the tube, no matter how carefully the latter is done, than by any particular method in performing the operation itself. E. B. R.

CASTRATION

Castration has been practised upon domestic animals for various reasons from the earliest times. Male animals whose flesh is used for human consumption—cattle, sheep, and pigs—are universally castrated. This effects considerable economy by doing away with the necessity for separating the male from the female members of the same species. Castrated animals develop better and fatten more easily and quickly, and their flesh is of better quality—less coarse and less likely to have an objectionable odour than that of uncastrated animals.

In the case of sheep the wool produced by the castrated male is considered to be of finer quality.

The male of those animals used for work—the horse, ass, mule, and ox—is castrated in order to render him a more useful servant of mankind, making him more tractable and enabling him to be placed in company with the female and other males of the same species, both at work and at rest. In this respect, however, one cannot fail to remark the tractableness and apparent inexcitability of the majority of the male animals in those countries where it is common to employ them uncastrated: custom and usage being great determining factors in this respect.

Occasionally castration is indicated in the surgical treatment of displacement, disease, or vice; as in the case of tumours or other diseased conditions of the testicles or their appendages, and accidental injuries to the scrotum and testicles, prostatitis, inguinal or scrotal hernia, cryptorchidism, masturbation, or viciousness.

Castration is dictated, too, by another reason of such wide and deep economic influence as in reality to outweigh in importance all others.

In the unnatural environment in which domestication has placed these servants of mankind, man's selective ability, gained by experience and observation, has been substituted for nature's selective method of the survival of the fittest in order that the standard of efficiency of these animals, both as regards their temperamental and their physical attributes, may be maintained, and, if possible, improved. Judicious mating of the male and female of domesticated species has replaced the promiscuity of nature. And though great improvement has resulted, there still is room for more. A stricter enforcement of registration of only those animals suitable for breeding would lead to results well worth attaining.

Methods of Castration.—The methods by which the operation is performed are numerous, and vary somewhat in the different species. The destruction of the function of the testicle may be brought about by the complete removal of the gland, or by the obliteration of the vessels leading to it, Siebold's and Burdizzo's method, or of the duct leading from it, vasectomy.

When total excision of the gland is practised the ideal method to be aimed at is one whereby a quick and sure check upon the hæmorrhage consequent upon severance of the blood-vessels going to the gland is obtained by the least damage to the tissues, accompanied by the least chance of infection of the cord and of the wounds of the scrotum.

Only those methods commonly employed in each species and regarded as being the best will be described. Space thereby saved will be employed to better advantage in giving more detailed descriptions of those methods recommended. This is necessary if the description of the operative technique is to be of any real service. Many men possess a natural manipulative dexterity. These have, or soon develop, a short and sure method of performing the operation of castration on the various domestic animals. Many, however, possess little or no such ability. To these, detail in description of both what to do and what not to do may lead to a certain amount of proficiency and success by a much shorter route than the route—often a very long one—of personal experience and observation.

In giving minute details of the digital manipulation of the testicle and its appendages, and of the various instruments used in the methods here described, the writer by no means wishes to infer that these only are correct, or that any others cannot be just as good. He wishes rather to convey the impression that whatever method is employed it should be followed with such attention to detail that no unnecessary handling of tissues or instruments occurs. That all movement should be definite of purpose and distinctly consecutive is as important in this operation as in any other, and if this principle is carried out from the first, such a degree of certainty of purpose and of execution will be developed in the mind and hands that much valuable time will be saved, and satisfactory results obtained.

Provided the rule that " efficiency must not be sacrificed to speed " is followed, anything in connection either with the method employed for restraint, or with the performance of the operation itself that tends to lessen the time occupied and to render the operation simpler and easier, is of the utmost importance, and has a direct bearing on the results obtained.

The writer fully recognizes in writing upon a subject about which there is such a diversity of opinion as to methods, or details in carrying these out, that there must of necessity be many who will not agree with what is stated here. Those that are satisfied with the success of their own methods have no need, and would be ill-advised, to change them for others.

Restraint.—In connection with his various operations the veterinary surgeon is constantly called upon to restrain effectively his patients. And in no part of his work is more effectual restraint required than in castration.

It is essential that the method of restraint adopted shall be easy and quick of application, effective and secure when completed, and easily and quickly removed. Further, it must be applied with every regard to humanitarian principles. Although this applies to all the domestic animals with which one has to deal, it is, however, more important in the case of the horse since he is the largest, strongest, and most valuable of them all : and especially is this the case when the operation is performed on the animal in the recumbent position.

The actual operation of castration is comparatively simple, and, provided that one possesses ordinary knowledge of surgical technique, proficiency in performing it can be acquired easily. Restraint, however, is an entirely different matter. An extensive knowledge and experience of the handling of horses is a great asset. It is necessary that this should be supplemented by the knowledge of the application of the various methods of restraint, and by confidence in one's own ability to apply them effectively. This knowledge and confidence can be attained only by practice and experience, although some men acquire them more quickly and more thoroughly than others. The necessary dexterity, nerve, and physical strength are not shared equally by all. Many men appear to possess an inborn ability to control and command animals.

This efficient handling and securing of animals is necessary if avoidable accidents to the operator, his assistants, and the animal are to be prevented.

The surgeon should personally assist in applying the necessary restraint, and if he is thorough, he himself will do the principal work in securing the animal. There are some accidents that are unavoidable, and will occur even with the most careful and experienced operator in attendance, but considerably more will occur if the application of restraint is left to others.

A description of all the methods of restraint that may be employed is not intended. Restraint is dealt with in another part of this book. A few details, however, of special methods of restraint that the writer has found successful in dealing with the various animals will be mentioned.

The general principles followed in castration are the same for all animals. Aseptic conditions should be observed where possible, but in the majority of cases environment and unalterable circumstances render their attainment an impossibility. Antiseptic methods, however, can, and should, be employed always, although, judging by the results obtained where they are not observed, some might be tempted to think that they are not essential. However, the extra care and trouble spent in taking strict antiseptic precautions are more than repaid by the better results obtained in all cases, and bad, or perhaps fatal results, though they cannot be wholly averted no matter what method is adopted, will be very much fewer, and when they do occur there will be nothing for which the operator can reproach himself.

No special preparation, other than keeping the animal short of food for some twelve to twenty-four hours before operating, is necessary.

After - treatment consists in keeping the animal under such conditions that infection of the operation wounds is least likely to occur, and where he can be observed and, if necessary, suitably fed and exercised.

Anatomy. — Though many thousands of animals are castrated annually by persons possessing no technical knowledge of the anatomy of the male reproductive glands and their surroundings, a clear and definite understanding of the structural anatomy of these parts is, however, essential to the surgeon if he is to possess the knowledge and consequent confidence to enable him to perform the operation of castration in a skilful manner, and be prepared to encounter and successfully deal with any abnormality that may exist, or untoward circumstance that may arise in connection with the operation. And especially is this necessary to enable one to operate successfully upon cryptorchids.

The testicle is intra-abdominal during early development of the fœtus. During its descent before reaching the internal abdominal ring it is suspended in a fold of the peritoneum ; this fold becoming later the tunica vaginalis propria. On its further descent through the inguinal ring and canal to the scrotum the testicle carries with it another layer of the peritoneum, the tunica vaginalis reflexa, and portions of the tissues forming the abdominal wall. These constitute the various layers of the testicular sac. Its descent into the scrotum is usually complete at or about the time of birth. Often one or both are retained in the inguinal canal, and the descent into the scrotum may be delayed for three or four years unless the animal is previously operated upon. Occasionally this retention is permanent, and may be abdominal also. This condition constitutes cryptorchidism.

In rare cases the testicle, though it has descended from the abdomen, has taken an abnormal subcutaneous position away from the scrotum. This condition is encountered with almost equal frequency in cattle, sheep, pigs, and dogs, but very rarely in the horse.

The term scrotum is somewhat loosely applied, and by it is understood generally the common covering and individual sacs which protect and partially support the testicles. In a more restricted and truer sense it is the name given to that modified, bag-like portion of the skin, situated at the extreme infero-posterior portion of the abdominal wall between the thighs, that forms the external covering of the testicular pouches. It is thin and elastic, smooth and covered with fine hairs, and on its whole surface has numerous sebaceous and sweat glands. All of which qualities specially adapt it in all circumstances for acting as a covering and protection to such important organs.

It is divided mesially by a longitudinal furrow, more or less unevenly, since in the majority of cases one testicle, the left, is larger and hangs at a lower level than the other. Along this furrow is a distinct line or *raphe* continuous behind with that of the perineum and in front with that of the sheath.

Immediately under the skin and firmly adherent to it is a reddish yellow tissue—the dartos. This is composed of fibro-elastic tissue containing unstriped muscular elements, and is continuous with the subcutaneous fascia. In reality this layer consists of two separate pouches which blend inferiorly on their inner sides to form the septum scroti in line with and above the scrotal raphe. Superiorly these sides diverge again to allow for the passage between them of the penis, to which they act as a kind of sling. Superiorly the mouths of the pouches become thinner and adherent to the abdominal wall around the external abdominal ring. The dartos is loosely attached by areolar connective tissue to the underlying tunics except at one particular point—the postero-inferior extremity. Here it is firmly adherent to these tunics and indirectly to the tail of the epididymis. This connecting band constitutes the scrotal ligament and is a remnant of the *gubernaculum testis*.

The scrotum normally, when the animal is in good health, assists in supporting the testicles. This depends upon the state of tone in the muscular elements in the dartos. Further, these muscular elements contract under the influence of cold ; the scrotum becoming drawn up and markedly wrinkled. Under the influence of heat or loss of tone from fatigue or debility, they relax, allowing the testicles to become pendulous, the scrotum smooth and having a marked neck superiorly.

Anatomically it is customary to describe as separate structures the next three layers internal to the dartos. From outward to inward they are : the spermatic fascia, continuous with the tendon of the external oblique abdominal muscle ; the cremasteric fascia, continuous with the tendon of the internal oblique muscle; and the infundibuliform fascia continuous with the transversalis fascia. These form a complete covering to the next and innermost layer, the tunica vaginalis reflexa, which is closely adherent to, and considerably strengthened by them in its lower part.

In connection with the cremasteric fascia is the external cremasteric muscle, a wide flat muscle which arises from the iliac fascia and passes down through the inguinal canal covering the postero-external surface of the tunica vaginalis reflexa, into which it is inserted toward the lower outer surface by numerous short tendons. Contraction of this muscle raises the tunica vaginalis reflexa and along with it the testicle.

The tunica vaginalis reflexa is the innermost layer of the scrotum. It is the parietal layer of the tunica vaginalis, and is a fibro-serous sac continuous with the abdominal peritoneum brought down by the descent of the testicle. It extends from the internal inguinal ring above downward through the inguinal canal inclined slightly inward and backward to the bottom of the scrotum below. It is somewhat pyriform, the lower dilated portion containing the testicle and its epididymis. The upper narrower portion which lies in the canal, gives passage to the spermatic cord. Its extreme upper limit opens directly into the abdominal cavity.

This opening should allow only of the passage of the blood and lymph vessels, the nerves of the cord and testicle, and the *vas deferens.* When, however, it is abnormally wide a loop of intestine or a portion of the omentum may pass through into the cavity of the tunica vaginalis, either remaining in the region of the inguinal canal alongside the spermatic cord, or descending to the bottom of the sac alongside the testicle, thus constituting respectively inguinal or scrotal hernia.

The visceral layer of the tunica vaginalis or *tunica vaginalis propria*, completely covers the spermatic cord, testicle, and epididymis.

Posteriorly the two layers come together forming a frenum, which extends from the extreme upper limit of the sac down towards the tail of the epididymis round the scrotal ligament. The cavity of the tunica vaginalis between its two layers is a potential one only, similar to those of the peritoneum and pleura. Normally it contains a very small quantity of serous fluid. This fluid when in excess constitutes hydrocele.

The testicles are suspended by the spermatic cords in a longitudinal position in their respective sacs. Besides varying in size in different members of the same species they usually vary to a less extent in the same subject: the left generally being larger and at a lower level than the right.

The testicle is ovoid in shape, but somewhat compressed laterally. The inferior border being markedly convex in both directions; the superior border which gives attachment to the spermatic cord is almost straight. The epididymis is attached to this border also and overhangs it externally. The epididymis which is formed by the complex coils of the excretory canal of the gland is divided for descriptive purposes into three portions: head, body, and tail. The head, or *globus major*, is closely adherent to the anterior portion of the testicle by the efferent ducts of the latter and by connective tissue, and is bound down to it by the common serous covering. The body, which is enclosed in a loose fold of this serous covering —the tunica vaginalis propria—passes in a backward direction along the junction of the spermatic cord and testicle slightly overlapping the outer surface of the latter. The tail, or *globus minor*, is firmly attached, but not so closely as the head, by a thick fold of the tunica vaginalis propria to the posterior extremity of the testicle. The efferent ducts come together to form the vas deferens, which as it leaves the tail of the epididymis is very convoluted. This, turning inwards and forwards, becomes straight and passes up the inner side of the cord towards the posterior border in a fold of the serous covering. At the entrance to the abdominal cavity it leaves the other elements of the spermatic cord, passes backward and inwards to the pelvis lying in the free edge of the urogenital fold, and crosses the ureter and the round ligament—the remnant of the umbilical artery—in the free edge of the lateral ligament of the bladder. Gaining the dorsal surface of the bladder it turns backwards, becoming dilated, and passes along the neck of the bladder under the prostate gland, accompanied by its fellow of the opposite side, where it joins the duct of its corresponding vesicula seminalis forming the ejaculatory duct—a short duct which passes through the wall of, and opens into, the urethra. The wall of the vas deferens is thick. Externally, with the exception of the last few inches of its course, it has a sero-fibrous tunic, and under this a thick muscular coat of longitudinal and circular layers. Internally it is lined by a mucous membrane with columnar epithelium. This structure gives the cord a firm cord-like character which simplifies its detection, a factor which may assist in locating the testicle in cryptorchid operations.

The spermatic cord is composed of the structures brought down by the testicle during its descent from the abdominal cavity to the scrotum. Its constituent parts come together at the internal inguinal ring, from whence it descends in the vaginal sac to become attached to the upper border of the testicle, covered for its entire length by the tunica vaginalis propria. Its anterior margin is rounded and free; its posterior is continuous with the tunica vaginalis reflexa. Under this serous covering it consists of the spermatic artery and veins, lymphatic vessels, nerves, vas deferens, internal cremaster muscle, and the cremasteric artery. The first four of these structures are bound together with loose connective tissue to form the anterior or vascular part of the cord. The vas deferens, as has already been said, is situated in a serous fold on the postero-internal aspect of the cord. The internal cremaster muscle consists of bundles of unstriped muscular tissue extending from the internal inguinal ring to the testicle and epididymis interspersed in the tissues of the cord. Its action is to draw the testicle upwards. The cremasteric artery supplies the tissues of the spermatic cord. It is usually the first branch given off from the external iliac artery but occasionally arises direct from the posterior aorta. The spermatic artery supplies the testicle and the epididymis. It arises direct from the posterior aorta and passes down the anterior portion of the spermatic cord, making many flexions and convolutions, especially in its lower part just before reaching the testicle. The satellite veins form a remarkable sinuous convoluted mass around the coils of the artery, forming what is known as the pampiniform plexus. The nerves are derived from the sympathetic system.

The Bull.—The scrotum has a well-marked neck and is much longer, more pendulous and slightly more hairy than in the horse. It is invariably flesh-coloured except in the naturally black-coloured breeds. The testicles are oval, more elongated, and relatively larger than in the horse, and their long axis is vertical. The head of the epididymis is flat and long, partly covering the anterior border of the testicle.

The spermatic cord is comparatively longer, but otherwise similarly constituted.

The Ram.—The scrotum in some breeds is covered with hair similar, but less in amount, to that growing on the face. In others the scrotum, particularly on its lateral aspects, is covered with wool.

The shape and disposition of the scrotum and testicles are similar to those of the bull. The glands are very voluminous.

In some breeds of goats in Eastern countries, the mesial groove of the scrotum is very marked, and in some animals to such an extent has this developed, that each testicle is suspended in an entirely separate pouch from the neck of the scrotum downwards.

The Boar.—The scrotum in this species is not well defined. It is situated posteriorly towards the perineal region. The testicles are relatively large and ovoid, their long axis being downwards and forwards. The tail of the epididymis, which is large in comparison, is dorsally situated towards the anus. The spermatic cord is more friable than in other species, especially in the young animal.

The Dog.—The scrotum is in the perineal region also, but well defined and sparsely covered with fine hairs. The testicles are firm and roundly oval in shape.

The Cat.—The scrotum is situated slightly more posteriorly than in the dog and is thickly covered with fur. The testicles are firm and oval. The inner tunics of the scrotum are very tough and fibrous and closely applied over, though not adherent to, the testicle and epididymis.

Castration of the Horse

The male of this species may be castrated from a few months old up to any age.

Excepting the comparatively small percentage of animals that may be used for stud purposes the majority are operated upon at from one to two years old.

The best age, and consequently the commonest at which young animals are castrated, is about one year.

It has been said that when the operation is performed on animals a few months old, there is less danger of injury and less notice taken of the operation. It is not popular, however, owners holding, and probably rightly, the opinion that it is not advisable, during the first nine months of a colt's life, to run the risk of doing anything that might lower its vitality and hinder its development.

It is a debatable point, too, whether injury is less likely to take place at a period when, though there is less strength there is immature development, than when there is more strength but better development. Certain it is that quite a large number of foals suffer from inguinal or scrotal hernia, whereas the percentage so affected at one year old is very small.

In unthrifty and undeveloped colts the operation should be postponed until they are two years old.

The time of the year at which the operation may be performed is quite immaterial as far as an adult or an animal that is going to be housed is concerned. It has no effect practically upon the result. All that is necessary is that a clean stable be provided and the animal exercised daily. In the case of young animals, from the beginning of May to the end of August is the time usually preferred. The milder and warmer weather of this time of the year is not so much responsible for the better results as is the more thriving condition and better health of the animals. That they can be turned out to grass is perhaps the greatest factor of all. No colts do so well as those that are turned out directly after having been operated upon and no further notice taken of them.

It used to be advised that they should not be allowed out in the rain. Little or no harm will result, however. Far better let the colt run the risk of a soaking from the rain than that of infection from an unclean stable.

Experience teaches that cold weather with an easterly wind blowing is a time to be avoided for castrating colts. Certain it is that they do not do so well—in fact, many do badly—during such climatic conditions. The probable explanation is that there is a varying degree of infection in many cases, and though the biting cold of an east wind does not of itself cause the trouble in the wounded parts, it does, however, assist in lowering the animal's vitality and the body tissues' own natural defensive powers, thus allowing an aggravation and extension of an already existing infection.

Many advise that very hot weather also should be avoided, giving as a reason the more likely infection of the scrotal wounds by flies. To observe such precaution in the British Isles is unnecessary. The weather there cannot be too hot for the castration of horses. It is conceivable, however, that in some countries the very hot season should be avoided.

While the foregoing may be taken as a general guide for all colts, it may be observed that colts that have been wintered well can be castrated a month or two earlier: their testicles are better developed and their winter coat is cast earlier. Conversely, those that have wintered badly do not start thriving till late in the season: their testicles are ill-formed and their winter coat unshed. The shedding of the winter coat may be taken as an indication as to the time the individual colt is fit to be operated upon. Many hold that a colt castrated while the old hair is unshed always has a dull unthrifty-looking coat.

Preparation.—In order to lessen the risk of any injury occurring, the animal should be kept without food for twelve to twenty-four hours before the operation. This is more necessary when the animal is to be cast for operation than when the operation is to be performed in the standing position, especially so in the case of older animals and those of heavy breeds; although in the standing operation also it is very advisable, for there is certainly less tendency for hæmorrhage to occur following the use of an écraseur or emasculator if the animal has been well starved. And further, an animal inclined to show fight, will show less on an empty stomach than on a full one. Lastly, the necessity for casting an animal is always a possibility.

At one time it was considered necessary or advisable to give a dose of physic by way of preparing an animal, even a colt, for castration. This is quite unnecessary in young animals, and even in older animals living on hard food, all that need be done is to discontinue the corn for a few days. In the case of a gross conditioned horse of one of the heavier breeds, a dose of physic a week or so before the operation may be beneficial. An animal cannot be in too hard and good condition. The healthier the animal the better recovery he will make.

Care must be taken to ensure that an animal is in good health and not suffering from any disease that is likely to hinder his progress after the operation. In young animals, strangles is a disease to be particularly guarded against. No animal that has recently suffered from, or is possibly infected with, strangles should be subjected to the operation of castration. Serious trouble such as abscess formation in the inguinal region, and possibly peritonitis, may result. No matter what the actual cause of death following castration may be, it is always the operation that is blamed.

There is another point in the preparation of adult or old animals for castration, and that is the cleansing of the sheath. This is by no means necessary as far as cleansing for the operation itself is concerned, but is advisable in view of the possibility of excessive œdema of the sheath and penis following the operation. This may be aggravated and its treatment complicated by the accumulation of dirt and smegma on these parts.

The common practice, however, of doing this after the animal is cast and tied up ready for operation cannot be too strongly condemned. In the case of " broken " animals this can, and should, be done a day or two beforehand. In the case of young animals it is not necessary, and it is better to leave it undone than to do it at the time of operating.

Before proceeding with the operation by any method a careful examination of the scrotal region should be made in order to ascertain whether or not both testicles are present in the scrotum; whether there is any displacement or other abnormality of these organs, such as malformation, disease, or adhesion of the covering tunics; and whether a hernia—scrotal or inguinal—is present. In respect of this latter it is always advisable to ask the question whether there is any history of the animal having been ruptured as a foal. Although many such animals are completely recovered at one year old, one would proceed with more care, if possible, with such an animal, and if any doubt at all should exist in the operator's mind it would be better to postpone the operation to the autumn, or the next year. The slight inconvenience thus caused the owner will reflect less on the operator than would the loss of the animal.

Hydrocele, which varies considerably in degree, is often met with in unthrifty animals, or those that have been wintered badly; and occasionally in an animal in quite good condition. If excessive, it becomes necessary to distinguish it with certainty from hernia.

Careful digital palpation, keeping clearly before one's mind a mental picture of the anatomy of these parts—knowing what to feel for and feeling for it—will enable one to decide with a degree of certainty that one should have the confidence to act upon.

A sense of touch developed by the experience gained from digital examination of the scrotal region of every colt operated upon stands one in good stead when called upon to decide in such a case. The scrotal tunics, especially the tunica vaginalis reflexa, are often considerably thickened in these cases. If, however, nothing but peritoneal fluid be present, the sides of the sac can be approximated between the thumb and index finger. The testicle, too, is often ill-developed, soft, and flabby, making it necessary to distinguish between it and possible descended bowel or omentum. This can be done by making out its anatomical structure, and tracing back posteriorly along the frenum of tunica vaginalis propria to the junction with the tunica vaginalis reflexa. The external inguinal ring should be made out and the inguinal canal explored as far as possible. It is a good plan to make this examination without the application of a twitch, if possible. Even when its use is essential this instrument should be lightly applied. The animal may also be "coughed" by an assistant in order to help the detection of a small inguinal hernia. The procedure roughly outlined is that which should be followed in all animals: a few seconds will suffice where no suspicion of abnormality exists.

Operation.—The horse may be castrated in the standing or recumbent position. Each of these two methods has its staunch supporters. Unfortunately there has been a tendency for a supporter of one method to endeavour to establish it by decrying the other, rather than by successfully demonstrating the superiority of his own method.

The writer does not aim at establishing the credit of one method at the expense of the other. His aim is to state fairly the advantages and disadvantages of both. If, in doing so, he should appear to be prejudiced in favour of the standing operation the reader should consider that this method is the one which he has consistently followed and staunchly advocated for many years.

Standing Operation.—Although a certain amount of physical strength and dexterity is required for carrying out this method of operating, a much more valuable asset for a surgeon, if he is to become expert, is an intimate knowledge of the handling of horses and the ability and experience to apply such knowledge. He can then undertake the operation with every confidence, and will soon make use of and appreciate the advantages it has to offer.

A previous experience of castrating in the recumbent position is very valuable—in fact, necessary. For, apart from the knowledge thereby gained of the handling of animals of all kinds, the knowledge of the anatomy of the scrotal region, and of the various methods applied and instruments used in performing the operation, there is also the fact that the surgeon has always to be prepared to perform the operation in the recumbent position, either on account of an existing abnormality, or some untoward circumstance arising. In the case of the latter a good sound knowledge gained by previous experience is essential.

Probably the greatest advantage of this method is that little assistance is required: one good man at the animal's head, and possibly, but by no means necessarily, some one to hand the instruments to the operator. It does not require much experience in country practice to find out how difficult it is in many instances to obtain the help necessary for casting animals, and when it is forthcoming, how often it consists of old men and very young boys.

It is a great advantage to have assisting one a man who has been trained to take charge of the head. He will not spend his time looking to see what the operator is doing, but will watch for and anticipate what the animal is going to do. It is advisable, however, to enquire as to the possibility of help in case of emergency; and in this respect a surgeon should always provide himself with some "tackle" with which he can cast an animal if necessary.

Other undoubted advantages of the method are: less physical exertion to the operator, especially if he takes part in securing the animal in the recumbent position; the operation is performed where the animal is caught and a great amount of time is thus saved, and for this reason, too, rainy weather need not necessarily interfere with arrangements.

What is thought by many to be the chief disadvantage of the method is the supposed greater danger to the operator. This is more apparent than real, if he knows his job. It is really remarkable how few animals give any great trouble. It is exceptional for one to kick. The older animals sometimes do so, and then only when the incision through the scrotum is made; but if the operator is standing in the proper place he is not likely to be touched.

Occasionally a colt, especially a thoroughbred, will throw himself down, and may do this so suddenly as to constitute a danger to the operator. Here again, however, if he does not lose sight of the possibility of this occurring and always maintains a correct position, few accidents will occur. Occasionally a really vicious animal is encountered. Time should not be wasted and unnecessary risks run in a senseless endeavour to operate on such an animal standing.

One other disadvantage is always put forward, namely, the descent of bowel resulting from an undetected hernia. If the examination of the scrotal region before operating has been as careful as it should have been, this is no more likely to occur than it would be had the animal been cast. For if it is so slight as to be missed during manual examination before casting, it is more than likely that it would not manifest itself while the animal is down but would descend when the animal rose.

The advantage of the recumbent position is that the actual operation can be proceeded with without interruption. Many assert that it is necessary if real surgery is to be accomplished.

That observance of strict surgical methods does not of itself ensure success in castration, no matter how much it may deserve it, is an indisputable fact, and one that will be impressed all too surely upon the novice. Surgical methods which are successful can be applied equally well in the standing or recumbent positions. The latter position has the advantage that the animal is already in a suitable position for remedial measures in case of severe hæmorrhage immediately following the operation. Such an eventuality, however, is exceedingly rare.

The adoption of the recumbent position is necessary if a general anæsthetic is given; in cases in which any abnormality is in existence, such as inguinal or scrotal hernia, and adhesion or disease of the testicle or its appendages; and when dealing with a very vicious animal.

Some of the disadvantages of the method have been mentioned when dealing with the standing method: the amount of assistance and the greater exertion required, the necessity of moving the animal to a suitable place for casting, and the longer duration of the operation. The risk of injury to the animal, especially in old heavy horses, during or consequent upon casting and securing does exist. Injury may be serious or slight, permanent or temporary.

The assumption that the castration of a young unbroken animal in the recumbent position is accompanied by less risk to those engaged in the task than when the operation is performed in the standing position is erroneous. These animals always show more fight in the open, and quite considerable risk is run before the animal is tied securely on the ground. In the standing position the risks are encountered during the operation. In the recumbent position equal risks are encountered before the operation.

Use of an Anæsthetic.—The advisability of, and the necessity for, administering a general anæsthetic before castrating any member of the equine species, no matter of what age, are questions over which there have been, and for a certainty will be, many discussions. Some hold strong opinions for its adoption, while others hold equally strong opinions against. It is conceded that the supporters of either view are honest in their convictions, and the decision to employ an anæsthetic or not in the case of young unhandled animals is left to them, and no effort is made to influence their opinions.

Of course it is out of the question to employ a general anæsthetic when the animal is operated upon in the standing position, although there is no objection to administering some hypnotic, such as chloral hydrate, when operating by this method upon animals other than young unbroken ones.

A general anæsthetic should be given when the operation is performed in the recumbent position in all but the young unbroken animal. If the operator holds the view that the latter should not be castrated except under the influence of an anæsthetic, to be consistent in his humanitarian principles let him become proficient in administering an anæsthetic to the standing animal. This in the writer's opinion is the only justifiable method of administering chloroform for performing the operation of castration upon young animals. If the animal is cast before administering the anæsthetic, then he will be conscious of much more than half of the total shock and fear that he undergoes, and the advantage of the anæsthetic as a means of restraint will be lost.

Since by far the greatest number of animals are operated upon at the age of one or two years the method of dealing with them will be described, and any difference in the case of older horses mentioned afterwards. As was stated earlier, particular attention will be paid to detail in handling, since this is essential to good operating.

Many veterinary surgeons are in the habit of having colts haltered in readiness for them; some refuse to do the operation unless this is done. Sometimes this haltering is done the day before; or it may be done only just before the surgeon's arrival, in which case the animals are almost sure to be in a "muck sweat." In any case they are usually in a more nervous condition than they would have been had they been left unhaltered, for the catching of them is left generally to a man unsuitable for the job, and has been accompanied by much shouting and hustling. Occasionally of course it has been done by the owner himself, or some one who is a horseman and knows what an advantage quietness is. The catching of young animals by the operator himself or under his direction may entail a little extra time, but is generally worth while by rendering the handling of the animals easier; and especially is this so if the standing operation is going to be performed. Further, there is more tendency to hæmorrhage —though not necessarily serious—and less favourable results in animals that are in an overheated condition.

The haltering of animals as foals and teaching them to lead should be encouraged, for this enables them to be handled and dealt with not only for castration but for other purposes.

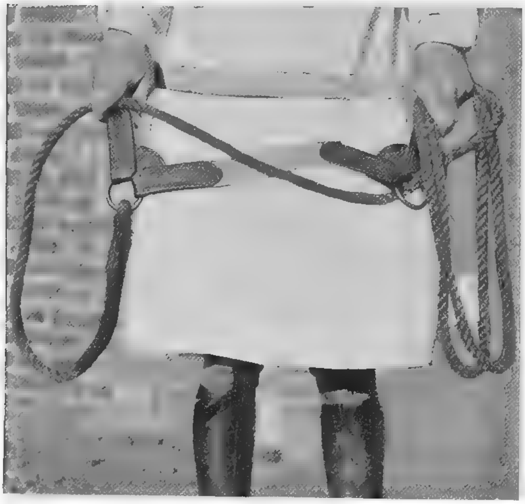


FIG. 297.—Halter, showing correct method of holding it.

In any case, one should always be provided with a useful halter such as that shown in Fig. 297. It consists of a head-piece and nose-band made of strong webbing. Both are bound by stout leather to a brass ring at either side and are maintained at right angles to one another by a strong corner stay of leather. This keeps them in proper relationship to one another and aids materially in putting on the halter. A twelve-foot shank is spliced on to the off-ring and passes through the near one. By having rings the shank will draw tight easily, and the halter be adjusted into its proper place instead of pulling off, as happens generally with an ordinary hemp halter without rings, if the animal should move before it is correctly placed. The correct method of holding the halter is also shown in Fig. 297. A fairly roomy loose-box or building is the best place for catching the animals. They should be quietly driven into one corner, and if possible kept there. By exercising a little patience they can be approached and the halter placed across the back just behind the withers; the right or left hand being over the back according as to whether one is standing on the near or off side of the colt. The halter is gradually pushed up the neck until the nose-band, with the shank crossing it as shown in Fig. 297, is over the ears, when it is released—in many cases the colt throws up his head when the nose-band touches his ears and so aids the putting on of the halter if it be released quickly—and the shank will swing round under the lower jaw. Occasionally one comes across a particularly nervous animal that will not allow himself to be approached near enough to do this by hand. In this case a long stick may be used with which to put on the halter. The shank between the two rings is wound round the stick once or twice and the halter laid carefully on the animal's back and gradually drawn up the neck until the nose-band is over the ears—not so easily done as said perhaps, but possible by exercising patience. Do not twist the head-strap round the stick and so have to bring the halter towards the colt's head from the front. Much time and almost all patience will be used up by so doing. No severe pulling on the halter should be allowed, except from directly in front of the animal, otherwise he is likely to rear and be brought over backwards, when injury to the head may possibly result.

A word of warning might be given here. Never have animals in a stable where there is a long, low, wide manger across one end, as is commonly used for cattle. It is very easy for an animal either to stumble sideways into it or to get knocked into it if several animals are in the stable. It is almost impossible to get an animal out of such a manger without serious injury of some sort. The writer has anything but pleasant recollections of having to cut through a nine-inch oak post with a hand-saw with the colt's legs flying about overhead, on an occasion when he had been tempted to take chances in such a building, none other being convenient at the time.

After catching the animal the procedure differs somewhat according to whether the standing or recumbent position is going to be followed. The standing method will be described first.

Instruments and Appliances.—All employed in this method are equally applicable to the recumbent position. A few used in the latter, however, are not serviceable in the standing position and will be described later.

Those required are: a knife for exposing the testicles; an emasculator or écraseur for removing them, or caustic clamps for applying to the spermatic cords; if these are used, a pair of steel forceps for closing them securely will be required, and also a pair of scissors for excising the testicles below the clamps. Further requirements are: a tray for the instruments; a spray containing tincture of iodine or iodized chloroform for disinfecting the scrotum; a strong twitch; a pair of blinds; a smock-coat; and a clean basin or bucket with water, soap, and a towel.

Besides these instruments actually required for the operation the surgeon should be provided with those that might be required in case of emergency: dressing-scissors, forceps, suture-needles and material, hernia-needle, strong wooden clamp, cotton-wool and antiseptic, and some casting appliances.

Knife.—The object aimed at is to obtain at one attempt a good opening through the tunics as well as the scrotum. This can be accomplished with any pattern of knife in the adult animal or one in which the testicles are well developed, but is more difficult in a young animal with ill-developed testicles. A knife having a fairly straight edge is preferable. It should have a slightly curved cutting edge, a fixed handle, and be comparatively short. The all-important point in any pattern of knife that may be preferred is its sharpness.

Emasculator.—Various patterns are now commonly made. Only those of proved efficiency and reliable make should be employed, and even then there is perhaps a slight element of luck in obtaining an instrument of first-rate efficiency. Severance of the cord by these instruments is effected by a combination of crushing and cutting, and at the same time compression is exerted upon its proximal end. The "Safety" (Fig. 298) is probably one of the most reliable. Others are the "Reliance" (Fig. 299) and the "Huish-Blake" (Fig. 300).

Écraseur.—This instrument acts by crushing through the cord by means of a tightening flexible chain. The ordinary Miles's pattern (Fig. 301), or Robertson's, may be employed. Dewar's pattern (Fig. 302) is the best. This instrument, besides being made stronger and longer, possesses the advantage over other patterns of having a sliding lock on the screw thread which enables the chain-slack to be taken up quickly before applying the steady crushing action of the screw. The chain is strong and has a bevelled edge on one side, by which one is said to get a greater crushing effect.

It is advisable to take off the very sharp edges of a new chain and also of the slot through the end of the shaft by very slight application of fine emery-paper. The chain should be made quite pliable by freely moving its separate joints backwards and forwards by hand. This renders it very much less liable to jam and break. After use the chain should be freed of small particles of tissue, washed clean, rinsed in boiling water, dried, and kept in a jar of absolute alcohol—methylated spirit will not do. This not only preserves it in the best condition but sterilizes it ready for use, thus rendering boiling it unnecessary: a process which tarnishes it and lessens its pliability.

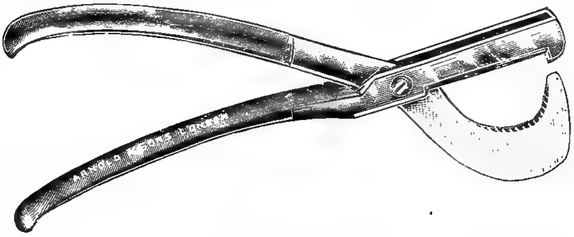
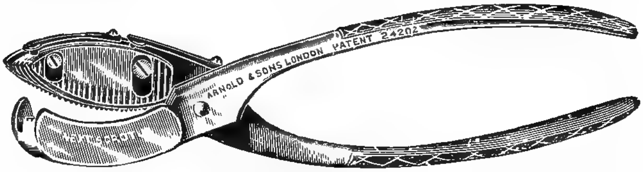


Fig. 298.—Safety emasculator.



299.—Reliance emasculator.

Many hold to the opinion that in using the emasculator or écraseur for castration the amount of hæmorrhage immediately following the removal of the testicle is directly proportional to the speed at which the instrument is used; that in the case of the emasculator it should be slowly closed and held so for some time and very slowly opened, and in the case

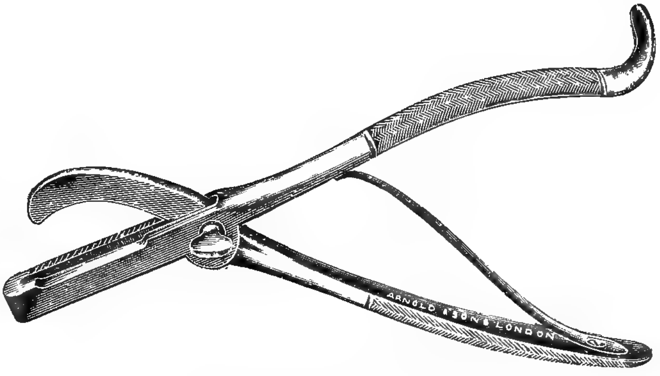


Fig. 300.—Huish-Blake emasculator.

of the écraseur that the chain should be tightened very slowly indeed. Greater factors in lessening the amount of hæmorrhage are: well starving the animal, and placing either instrument well up the cord above the extremely convolutive portion of the spermatic artery, closing the instrument on the cord while this is stretched taut, and cutting through the cord at a steady, moderate pace.

Caustic Clamp.—The most serviceable is a light round wooden one having the approximating surfaces of each half flat, upon which the caustic—coarsely ground perchloride of mercury is the best—is applied by means of some adhesive material, the two halves being tied at one end with cord and closed at the other by a leather ferrule. A pair of steel forceps should be used for closing the clamp, as then there is no fear whatever of the leather ferrule coming off or the clamp slipping. An ordinary pair of curved trimming-scissors—not serrated—with the points well rounded, are the most useful for removing the testicle below the clamp. Some operators remove the testicle by means of the same knife that they use for opening the scrotum: a bad practice, for not only is the edge of the knife destroyed, but by using a knife for such a purpose the animal is subjected to an unnecessary risk of injury.

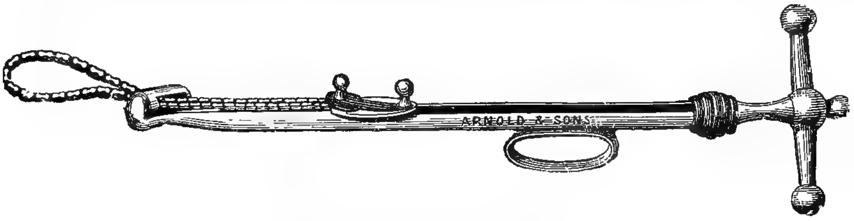


Fig. 301.—Miles's écraseur.

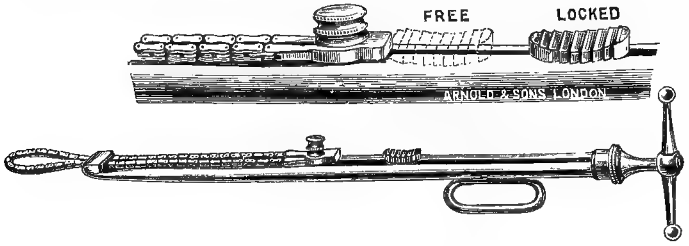


Fig. 302.—Dewar's écraseur.

Tray.—An enamel one containing some antiseptic solution of reliable strength. Any antiseptic that has no chemical action on metal instruments will do. For an emasculator or écraseur a wide-mouthed, deep enamel vessel, containing a 2 per cent solution of lysol or similar antiseptic, is better than a tray.

Spray.—Any spray having a more or less vertical jet answers the purpose quite well.

Twitch.—A good twitch with reliable cord of 20 to 30 loosely woven strands, and a strong handle about four feet long for young unbroken animals. For use on adult or broken animals a handle not more than two and a half feet long is equally efficient and easier to manipulate.

Blinds.—Should be small and tight-fitting. An ordinary stable rubber answers admirably, or a cloth about two feet square folded triangularly and placed across the eyes, the ends being twisted round the head-piece of the halter or bridle.

A blind is perhaps more effective in preventing an awkward animal from kicking than a twitch. Although by no means necessary in the great majority of yearlings of the heavier breeds, a blind is well worth the small trouble of putting on in all others and in adult animals.

If the operator adopts the method of using caustic clamps he will find great assistance in wearing a smock-coat having a left-hand breast pocket which has been stitched vertically into three divisions, in each of which he can put a clamp, its leather ferrule having been removed and put into the left-hand side pocket. The steel forceps for closing the clamp are put into the right-hand side pocket. The third clamp saves releasing the testicle in case a clamp has been knocked out of the hand on to the ground.

All instruments should be sterilized by boiling daily before being used, and then wrapped in sterilized lint. It is not practicable, neither is it necessary, to boil them between each operation if the surgeon is operating on many animals on the same day. If care is taken in looking after the instruments the disinfection by an antiseptic of reliable strength is sufficient.

Operation.—The technique of the standing operation is the same for old and young animals. Before commencing the operation the surgeon should take care that everything for the completion of it is in absolute readiness.

If the stable or building in which the animal has been caught is suitable as regards light and space, it is much better for the operation to be performed there; as the majority of animals will stand much more quietly indoors than out in the open.

A twitch is applied and the scrotal region carefully examined in order to ascertain that no abnormality exists. It is necessary to remember that the less time that is allowed to elapse between the application of the twitch and the commencement of the operation itself the better the animal will stand. If the animal is inclined to be very awkward the next step may be dispensed with. Tincture of iodine is applied to the scrotum. This is done much more effectively and easily by spraying than by any other method. The operator quickly washes his hands and rinses them in some antiseptic. The animal should be stood alongside a wall, with his off side to it but not too close. It should not be pushed back into a corner or on to a manger, as this only cramps the space between the thighs and belly. If possible the animal should be so placed that the light falls on the scrotal region; this is not really necessary, however. The man holding the twitch, which is now tightened, also holds the shank of the halter and endeavours to keep the head a little inclined towards the near side, or this may be done by another man holding the shank short in his left hand and placing his right hand on the side of the neck. The instruments should have been placed where they can be got at readily, or may be handed to the operator by an assistant.

The operator then stands on the animal's near side as near the elbow as possible, taking care to see that no one is standing just behind him so that he cannot step back quickly if necessary. With the thumb and index-finger of the left hand, the palm of the hand away from the scrotum, he seizes the off testicle covered by the scrotum. Occasionally it may be necessary when the testicle is small to grasp it with the right hand first and draw it down gently so as to enable a suitable hold to be obtained with the left. It should be so held that the scrotum is stretched tightly over the testicle, and by exerting a fair degree of traction and well flexing the wrist the testicle and scrotum are brought into such a position as to enable a bold incision to be made, with the knife in the right hand in front of the near hind leg, in a downward and backward direction, freely exposing the testicle at one stroke. If the incision is as bold as it should be, and is made backwards and upwards, there is a risk of injury to the colt's thighs, and should he snatch up the near hind leg, as he sometimes does, the right arm clasping the knife in the hand is in such a position that injury to the operator's left arm or hand may result.

Some operators say that they never look at the scrotum, not even when making the incision. If this is so they either possess an invaluable sense of touch and direction, or show an entire disregard of injury to themselves and the animal. Certainly, with the exception of making the scrotal incision, it is best not to bend down and look up into the scrotal region. There is no necessity for it; the operation can be perfectly performed by digital manipulation only. The operator can maintain a much safer position by not so doing; and he will have less pain in his back at the end of a big day's work.

When the testicle is liberated it is grasped at its junction with the cord by closing the third and fourth fingers of the left hand over it in the form of a clamp without withdrawing this hand from the scrotum. By holding it in this way the thumb and index-finger are left free to direct the placing of whatever instrument is used, and keep the scrotal integument and tunics clear of it.

Care should be taken not to handle in any way the cord above where it is going to be severed. Slight traction is put upon the cord: the animal will draw against this at first, but will soon give way if it is slight and maintained. It is at this time that the animal is inclined to throw himself down or lie over on to the operator. The operator should keep himself well clear of the animal, not only for safety, but because the animal is very much less likely to lean over. If the animal is inclined to walk on, let him, or make him do so if he will not give down the testicle.

If the emasculator is used, it is grasped in the right hand by the handles and its jaws put round the cord, care being taken that they are above the epididymis and well up the cord and at right angles to it. Traction is exerted on the anterior or vascular portion of the cord so that the instrument can be placed on the cord above the convoluted portion of the artery when it is on the stretch. The instrument is then firmly and definitely closed, and gently opened. Similar procedure is carried out in connection with the near testicle.

The écraseur is used in like manner; the testicle being passed through the chain loop and the latter directed well up the cord. The chain-slack is taken up tightly by manipulation with the right hand, while the left maintains the vascular portion of the cord on the stretch. The shaft of the instrument is then grasped by the left hand and the handle turned by the right until the cord is cut through.

If a wooden caustic clamp is used the testicle is maintained in the same manner, the clamp being placed high up on the cord by the right hand from behind forwards, being directed by the thumb and index-finger of the left hand. The cord is placed well into the back part of the clamp, the front ends of which are then grasped by the thumb and index-finger of the right hand and brought together; the left hand, liberated from the testicle, quickly places the leather ferrule on the clamp. The clamp is seized by the steel forceps behind the ferrule and in front of the cord and closed tightly, and the ferrule pushed well home. The testicle is removed by scissors about one inch below the clamp, and thus prevents the clamp being pulled off.

In young animals the sooner the clamps are removed after six hours the better. In no animal is it necessary to leave them on longer than the next day. Before being removed the remainder of the cord below the clamp is cut away with the curved scissors. The cord which fixes the clamp at its posterior end is cut by passing a knife into the notch between the two halves, the knife being given a slight twist so as to open the clamp, which is then gently removed from the cord, the end of which is returned into the scrotum by grasping the lips of the wound and pulling them downwards. Occasionally considerable swelling of the scrotum and prepuce has taken place before the clamp is removed. This is due not to infection, but to the formation of a blood clot between the scrotum and tunics caused by bleeding from a severed vessel — more commonly a vein—either on the inner side of the scrotum or in the tunic wall. The lips of the scrotal wound close round the cord along the clamp and imprison this blood, which should be carefully removed. Otherwise it will form a very suitable medium for bacterial growth and may lead to trouble.

After-treatment will be dealt with later. In the case of broken and adult animals the procedure is almost identical.

The administration of some hypnotic such as chloral hydrate previous to operating may be adopted. A bridle should be used in place of a halter, and blinds invariably put on. There is practically no difference in the technique of the operation itself. If the cord is very big it may be necessary when using the emasculator or écraseur to sever the vas deferens and nonvascular posterior portion of the cord above the tail of the epididymis with a knife or with scissors, thus lessening the pain to the animal and relieving unnecessary strain upon the instrument.

The caustic clamp is the most reliable for old animals, and should be left on from eighteen to twenty-four hours.

The Recumbent Position.—In addition to the instruments and appliances mentioned in connection with the standing operation, excluding the caustic clamp, it is necessary to mention instruments for removing the testicle by actual cautery, and appliances for casting and securing the animal.

The use of the actual cautery for dividing the spermatic cord and arresting the hæmorrhage is one of the oldest, and until comparatively recent times one of the commonest methods employed. Although it earned its reputation before aseptic or antiseptic surgery was understood or even dreamt of, it can be used along with the application of present-day principles with such satisfactory results that it is still employed, and preferred by many.

Some employ it for making the incision through the scrotal tunics to expose the testicle in order that the scrotal wound shall not heal too quickly and prevent the escape of any discharge.

A steel clamp (Fig. 303), hinged at the end of the blades, which should be wide so as to prevent the heat of the iron, used for searing the cord, coming in contact with the skin, and usually having at the end of the handle a by no means necessary spring ratchet or hook with which to keep it securely closed when applied to the cord.

The pattern of iron used for burning through the cord and searing the blood-vessels is similar to that of the ordinary firing-iron. It is not necessary that the edge of it should be particularly sharp: if made thin and sharp it only becomes burnt and rough. Both the edge and the flat surface of the iron should be smooth. Care should be taken that they are not "burnt" when heated. If very scaly, this should be removed by a file or by rubbing on a piece of stone or brick. No irons work so cleanly and well as those heated in a wood fire. The iron should be at a dull red heat and free from all scales and ashes.

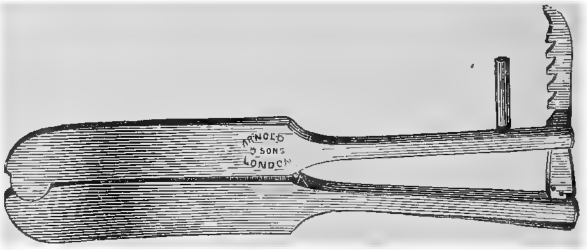


Fig. 303.—Steel clamp.

Restraint.—Many different methods of restraint employed for casting and securing animals for castration have been described at various times. Most surgeons have their own particular fads on the subject, taking exception to certain parts in some of the methods while adopting other parts, and maybe introducing some variation of their own. Any one who has adopted a certain method which in his hands has proved satisfactory and safe, and with which he is thoroughly acquainted, will naturally continue to employ it. Any one particular method with which one is thoroughly acquainted always appears to be simpler and easier than any other.

Those methods recognized as the best and most commonly employed have already been described earlier in this work. By some of the methods adopted the patient is secured in the dorsi-cumbent position, by others in the lateri-cumbent position. With the exception of those cases where some abnormality exists, such as hernia, scrotal or inguinal, or some displacement or disease of the testicle, the lateri-cumbent position is the better all-round method. In this the animal is cast on his near side and the off hind leg tied up.

The advantages claimed for it are: the methods of restraint usually employed can be more quickly and easily applied; less space and assistance are required, since the animal is better controlled and falls more or less where he stands; while being just as securely held, the animal is less liable to injury; the scrotal region is better exposed; and there is less liability of infection of the inguinal canals.

The double side-line, made of a single cord, or having a simple leather collar with two cords, is about the worst method. It may be the simplest and safest to those who apply it, but this does not justify its use. A considerable amount of room and assistance are required; the animal is more likely to fall badly; securing and releasing cannot be done quickly; the animal when secured can, and does, thrust his hind legs straight forward, in which position he is able to exert such muscular force that injury to the muscles or bones of the back and hind limbs may result; and, above all, the testicles are most inaccessible.

Bad as the method is for castration, its use in cryptorchid or hernia operation is most inadvisable.

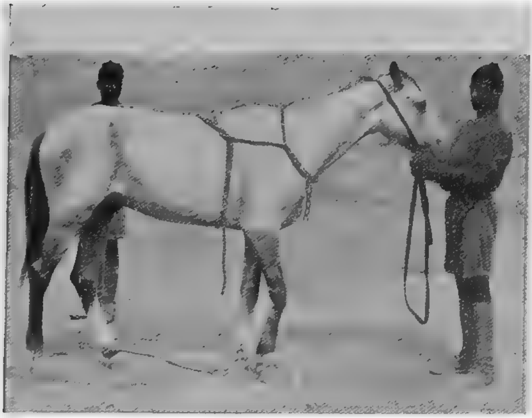


Fig. 304.—Method of casting colt for castration. Ropes adjusted ready for casting.

At the risk of occupying a little space a method that the writer has found serviceable will be described. Fig. 304 shows the method applied before casting, and Fig. 305 when the animal is secured. Four men only are necessary. No. 1 holds the twitch; No. 2 the halter until the ropes are adjusted, when he hands over the halter to No. 1 and goes to the off side; No. 3 stands on the off side and No. 4 on the near side of the animal. The operator himself usually being either No. 3 or No. 4, preferably No. 3.

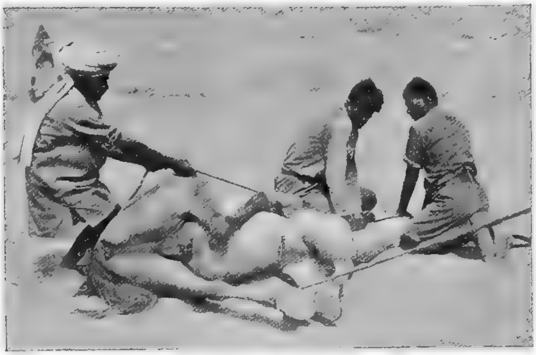


Fig. 305.—Method of casting colt for castration. Secured ready for operation.

A strong rope is used, on one end of which is spliced about a foot of plain chain, and at two and a half feet from the same end is fixed a quick release hook. The chain end is placed over the animal's neck by No. 3 standing on the off side, brought round under the neck and enclosed in the hook, the length of chain enabling the rope to be accommodated to the size of the neck. A half hitch is then made with the rope round the body just behind the elbows; the direction of the rope being over the back, down the near side, under the chest, up the off side, and passed double under that part of the rope coming from the neck, and laid across the back ready to be grasped from the near side. It is not necessary, in fact it is inadvisable, to draw the free end right through, as the rope will then be in the right position for releasing. No. 4 on the near side puts on the near hind fetlock a rope fifteen feet long and having a spliced noose at one end. This rope can be passed round the thigh, threaded through the noose, and allowed to descend into the heel, or the noosed end may be gently thrown between the hind feet on the ground and picked up with a stick and then threaded as before. Two webbing hobbles with metal D's (Fig. 306) are put on the fore pasterns, one by the man on the near side and one by the man on the off side. The end of the rope from the near hind pastern is then passed through the hobble D's from the near to the off side. No. 3 and No. 2, who has come from the head, grasp this rope, both standing in front of it, and so clear of the free off hind leg when the animal is on the ground. No. 4 seizes the doubled end of the neck-rope, and on a given word both sides pull steadily and firmly, pulling in a somewhat backward direction rather than at right angles to the animal's sides. When the animal is on the ground No. 1 pulls the head back and, kneeling on the neck, maintains it in this position. The animal may kick once or twice with the free hind leg. When quiet a double hitch round the near hind fetlock is made with the shackle rope, or if the animal should struggle very much and there is any danger of getting struck by the free leg the looped end of the neck-rope may be put round the pastern of the off hind limb, and this pulled slightly out of the way by exerting traction on the free end of the rope. Before securing the off hind leg the half hitch round the body should be pulled taut so that the bend in the rope is about half way up the chest wall. When the doubled end of the neck-rope has been put round the pastern of the off hind leg the free end is pulled until the foot is brought up to the chest wall just behind and above the elbow, and secured there by a double hitch being made round the pastern. The free end should be held by No. 4 with his knees pressing against the top of the animal's quarters, thus exerting a backward pull on the leg.

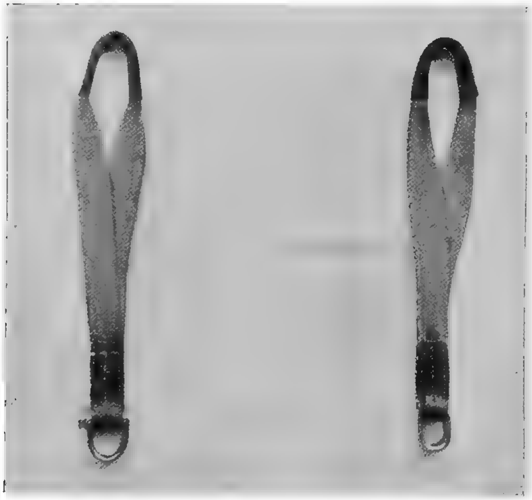


Fig. 306.—Webbing hobbles.
A, plain ; B, having a releasable "D."

When the operation is completed the animal is liberated by freeing the clove hitch of both ropes, the free end of the neck-rope being held firmly until the shackle rope has been taken off the near hind pastern and pulled free of the hobbles and these removed. The looped end of the neck-rope is then slackened and the off hind foot freed, and by pressing the spring catch holding the chain of the neck-rope all falls clear. The twitch is removed and the colt allowed to rise.

Operation.—After the animal has been caught he must be taken to some place where he can be cast. Nowhere equals a piece of clean level turf. A manure yard must be avoided, and no matter how dry the bottom of a straw-yard and clean the straw, it never equals the grass ; the straw getting in the way of the casting ropes and dust and dirt off the straw flying round and soiling the operation wounds and the cords.

If possible the animal should have been confined in a building adjacent to the place where he is going to be cast, and certainly not where he will have to go through, or have the chance of taking his attendants through, varying depths of liquid manure.

Before casting, a twitch is applied and the scrotal region carefully examined for any abnormalities, if this has not been possible before the animal was brought out.

When the animal has been secured the scrotal area is well sprayed with tincture of iodine. The surgeon now carefully washes and disinfects his hands, having any instruments he may require in a tray containing some antiseptic.

The operator stands behind the lower thigh of the animal, about equidistant from the root of the tail and the hock ; in such a position the scrotum is freely accessible. He should not stand directly behind the horse's buttocks, and certainly not behind his croup, leaning over the upper quarter. The left foot is placed on the hair of the tail close to the end of the dock in order to prevent this flicking on to the scrotum if the animal struggles.

To obtain an easy and good hold of the testicle the right hand is placed in front of the lower or near half of the scrotum, the thumb towards the pelvis and the fingers pressed down into the inguinal region. By approximating these above the testicle of that side and drawing the hand backwards the gland is brought into the bottom of the scrotum, where, covered by the scrotum, it is firmly seized by the right hand, the thumb pressed in above the gland behind the anterior vascular part of the cord and the fingers round its outer side and tucked in above, care being taken that the cord is not twisted, *i.e.* that the vascular part is in front and the tail of the epididymis directed backward. The testicle, covered by the scrotum, is now drawn down as far as possible so as to allow a good hold to be obtained by the left hand. The left hand, with the wrist well flexed, is extended so as to enable the testicle and cord to be grasped from the front. While the testicle is drawn down as far as possible with the right hand, the third and fourth fingers of the left hand, used as a kind of clamp, grasp the neck of that half of the scrotum, including the spermatic cord, from before backwards, holding it tightly, the thumb and index-finger grasping the testicle on its upper surface along the junction of the gland and spermatic cord, which is liberated by the right hand. By using the third and fourth fingers in this way the thumb and index-finger can roll the scrotum over the testicle in such a way that the scrotal raphe is parallel with the long axis of the testicle and in such a position that the incision through the scrotum and tunics will be about two inches to the outer side of, and parallel with, this line. When so placed the scrotum is stretched tight over the gland by a squeezing action of the thumb and index-finger above the testicle. The surgeon then takes the knife from the tray held by an assistant (or placed in a convenient position) and exposes the testicle by one free incision through the scrotum and underlying tunics, taking care not to cut down upon the lower thigh at the end of the movement. The hold of the left hand on the outer side of the scrotum is maintained while the knife is laid back in the tray. The exposed testicle is then seized by the right hand, the left releasing its hold completely without in any way manipulating the gland or cord. The testicle is not released by the right hand until whatever instrument is used is properly placed on the cord, which is done by the left hand.

It is very necessary to remember that it is during this particular part of the operation that the animal invariably struggles. The traction that is placed on the cord by the right hand, so as to enable the instrument to be put above the tail of the epididymis, and as high up as possible on the anterior vascular part, should be steady and maintained and not forced in any way while the animal is struggling. The contraction of the muscular fibres in the cord will soon be relaxed, enabling the testicle to be drawn down and the cord seized high up. Another point to observe always is that when once the instrument is round the cord the hand holding the instrument should be tightly pressed against the perineum whenever the animal is struggling, especially so when the cord has been finally seized. Whatever movement the animal makes the hand will follow it, and no traction on the cord by the instrument can take place and perhaps tearing result. If the posterior non-vascular portion of the cord is previously severed there is no difficulty in placing the instrument high up on the vascular portion. In the case of an old animal, however, the cremasteric artery may be of sufficient development as to cause considerable hæmorrhage if this part is divided by a knife or pair of scissors. If the actual cautery is being used the clamps can be closed on the cord above the epididymis, and the posterior part of the cord severed and seared; then by opening the clamps the vascular part can be easily drawn down to be severed at the proper level.

To continue the description of the operation. If an emasculator is used, the instrument is lifted from the tray by the left hand and the jaws put round the cord from behind forward, but not closed. Traction is put on the testicle and cord by the right hand, while the left, maintaining the jaws of the instrument free from, but close to, the cord, passes them up the cord, pushing back the scrotum and tunics until the cord can be seized, the posterior part about an inch or two above the tail of the epididymis, and the anterior part about three or four inches above its junction with the gland. The jaws are then firmly closed upon the cord by exerting pressure upon the handles. The right hand can release its hold of the gland and assist in the complete closure of the instrument if necessary. The testicle is lifted away and the instrument gently opened and replaced in the tray. The same procedure is then carried out in connection with the right testicle.

If the écraseur is employed the testicle is passed through the chain loop by the right hand, and again firmly grasped. The instrument is held in the left hand by putting the third and fourth fingers through the steel loop on the lower side of the shaft, and the thumb stretched out over the screw-head that maintains the chain-ends in position. The procedure is the same as with the emasculator: the testicle and cord are pulled down by the right hand, and the chain passed up the cord to the proper level, but first take up the slack by drawing back the thumb until only sufficient is left to allow the chain to move freely up the cord. The chain is then tightened by drawing on it with the left thumb, a good grip of the cord being made. The right hand, having released the testicle, and having pulled the sliding lock into position—if the instrument be a Dewar—proceeds to turn the handle gently and firmly until the cord is severed. The testicle is removed, and the right one treated in the same manner.

If the actual cautery is used the steel clamp is held by its left handle, the right one being tucked under the spermatic cord from before backwards. By supporting the right handle with one of the fingers of the right hand it can be grasped by the left hand behind the cord. The clamp is not closed tightly on the cord, the handles being kept apart by the little finger. Then in like manner to that in which the other instruments are used, the clamp is passed up the cord, pushing the scrotum and tunics in front of it. When at the proper level the clamp is closed upon the cord and the testicle released by the right hand.

It is necessary that the vascular portion of the cord should be at the hinged end of the clamp, for it is the more compressible part of the cord, and will be more securely held than if the non-vascular part, which is denser in structure, be at the hinged end. In the latter case the jaws might not grasp the vascular part sufficiently tightly to prevent its slipping through them after it is severed.

The cord is then seared about half an inch from the jaws of the clamp by the hot-iron held in the right hand. The posterior or non-vascular part is cut through first, not by a sawing motion but by pressing upon it with the iron at right angles to the blade of the clamp. The anterior or vascular part is severed similarly, but less pressure should be exerted with the iron than on the posterior part. The iron should be allowed to sink slowly through the tissues: very little more searing will then be required, and if by any chance the cord escapes from the clamp, due to the animal struggling or to some other cause, there is no need to worry further, for no severe hæmorrhage will occur. After the cord is severed the flat of the iron is lightly applied to the edges and whole surface of the end of the cord, chief attention being paid to the anterior part. It is also necessary to sear in the region of the vas deferens, which is usually about the middle of the cord as grasped in the clamp, because close to it is the cremasteric artery, though when once this is severed by the iron no severe hæmorrhage will occur from it. When the searing has been done the grip on the handles of the clamp by the left hand is slackened and they are gradually opened. This can be done easily, with a little practice, by the little finger of the left hand; or the right hand can be employed, either while still holding the iron or after having laid this aside, not on the ground. The slackening on the cord should be gradual and continuous. Avoid any opening and shutting action with the clamp when releasing the cord, for that will give a false idea of the artery not being properly seared: blood passes along the vessel when the clamp is slackened, and when closed again the pressure exerted upon this will burst open the seal formed on the end. If no bleeding occurs when the clamp is only just holding the cord, while the animal is exerting no pull upon it, it should be released by widely and quickly opening the jaws. If when the jaws are first slackened bleeding occurs they must be closed again, and the iron lightly applied to the part where bleeding appeared. The amount of searing done, however, should be the minimum necessity requires.

The artery should appear as a light-coloured ring more or less in the centre of the vascular part of the cord. Occasionally, if the cord has not been grasped high enough, a curved whitish mark is seen in the vascular portion after its surface has been seared, from which blood will escape on the clamp being slackened. The best way to deal with this is to cut across it at right angles with the edge of the iron. It is a convolution in the spermatic artery, and if one goes on using the flat of the iron the bleeding is most persistent; the reason being that the vessel is seared in a very slanting direction, or there may be a hole burnt in the side of it.

The right testicle is removed in the same manner.

The animal is then released and allowed to rise, and kept quiet until the surgeon has made his final inspection.

Although there is practically no difference in the actual method of operating on adult or old animals, a slight difference in restraint should be adopted. The animal, if not anæsthetized before casting, is thrown on the near side by some pattern of casting-hobbles that includes all four legs: Bracy Clark's, or for a thoroughbred and the lighter breeds a set after Miles's pattern, the hobbles being made of webbing with metal D's, and the one for the off hind limb having a special releasable D (Fig. 306, B). They have the advantage of being noiseless and less liable to bruise the heels when the animal struggles. A neck-rope, as already described, is put on and used as the "pull over" rope. The animal is anæsthetized with chloroform, and when ready the neck-rope is passed round the off hind pastern, the hobble on that limb released, and the leg pulled up and secured in a similar manner to that followed in the young unbroken animal.

Immediately following any method of operation, a varying degree of hæmorrhage often occurs. Although this would cause no uneasiness whatever to the surgeon, it often does upset the owner considerably, appearing to him a much more serious circumstance than it really is, and lowering his opinion of the operator's skill. A comparatively small amount of blood spread out on clean straw will give to the inexperienced the impression of a considerable loss to the animal. For this reason, if for no other, there is a preference for the clamp in the standing position and the actual cautery in the recumbent position when operating upon old animals.

There are several other methods of castration in which the recumbent position is necessary. They will not, however, be described in detail, since, apart from personal opinion, the infrequency with which they are adopted points to a very decided lack of reliance on them.

Castration by Torsion.—This method or a modification of it is still used in the smaller animals, but is not employed in castration of the horse as commonly as in former times. The testicle is exposed as in other methods, and the cord, after division of the posterior part, is seized high up with a pair of forceps or clamps which are held firmly. The testicle is then removed by twisting the cord and testicle until the cord tears below the forceps. This is done by hand or by grasping the spermatic cord about one inch lower down with another pair of forceps, which are rotated till the cord tears through.

Castration by Ligation of the Spermatic Blood-vessels.—Theoretically this method, applied under strict aseptic conditions, is the most rational. When careful attention to surgical conditions has been observed it has been successfully employed. In practice, however, owing to the unavoidable conditions under which the general practitioner works, operation by ligation has never become popular.

Vasectomy.—In this method the function of the testicle is destroyed by removal of a portion of the vas deferens.

Here again strict aseptic conditions must be followed. The vas deferens is exposed by making a small incision through the scrotum and tunics above the testicle. Two ligatures are applied to the duct about an inch and a half apart, and the intervening portion removed. The tunics and scrotum are closed by sutures. Though successful in abolishing the direct and indirect functions of the testicles, it is not recommended for general use.

After-treatment.—Young animals that have been castrated at the usual period of the year, between May and September, should be turned out to pasture on completion of the operation. Those do best that are so treated. The weather would have to be very unfavourable indeed to be as harmful as a closed stable or yard. In fact, it is very doubtful if inclement weather can of itself cause any harm.

Accidents and other Sequelæ of Castration

However regrettable they may be, some accidents are unavoidable in spite of every precaution and care.

There is always the possibility of an accident occurring during the casting of an animal for castration just as there is when casting for any other operation. The more common are injury to the back and limbs, fracture of bone and straining or bruising of muscles. In addition to these, however, are some peculiarly related to castration.

Fracture of Tibia.—Fortunately this is of rare occurrence. If the animal is secured in the laterocumbent position it is the tibia of the off hind limb that is fractured; if in the dorsicumbent position it may be that of either hind limb. It is the result of muscular contraction. A predisposing factor to its occurrence is the complete extension of the limb when secured. This allows a greater muscular force to be exerted than when the limb is flexed. Any method then of securing the limbs that tends to limit the ability of the animal to extend it completely will lessen the chance of the occurrence of this accident and should be attempted.

Hæmorrhage.—This may be primary, occurring immediately after the operation, or secondary, occurring at a variable period, from one or two days up to seven or eight, after the operation.

A variable degree of hæmorrhage often occurs during or immediately following castration, and cannot be looked upon as an accident unless it is of such degree as to necessitate surgical interference. Unless it is profuse there is no cause for alarm, and in the great majority of cases it will cease spontaneously. And in any case there should be no undue haste in applying remedial measures, for if these be adopted and the bleeding is from the cord this will be subjected to a handling that is better left undone unless really necessary.

It is possible when incising the scrotum when the testicle is ill-developed and not properly descended that injury may be done to some part of a plexus of large veins situated in the inguinal region between the scrotum and thigh. If this happens the hæmorrhage will occur at the time and before the spermatic cord is severed. If profuse it is best dealt with at the time by ligation.

If bleeding is profuse the animal must be secured in the recumbent position, and the vessel picked up and any one of the recognized measures for checking hæmorrhage that may commend itself to the operator applied—ligation, torsion, or actual cautery. Every care as to surgical cleanliness must be observed. Plugging is most unreliable, and unless sterilized material is employed is likely to cause harmful results.

Prolapse of Omentum or Bowel.—This may occur either during or after the operation. It may not occur until a few days after. The writer has observed prolapse of omentum ten days after the operation. Examination of the prolapsed portion readily determines its nature.

Prolapse of Omentum.—If this occurs at the time of operating, either in the standing or recumbent position, remove the testicle being dealt with, taking care not to include any part of the omentum in whatever instrument is being used; then seize the prolapsed tissue and withdraw any further part of it that comes very easily. The whole of the exposed portion is then removed. If it contains any prominent blood-vessels the removal can be done with an emasculator or écraseur; a pair of scissors will usually suffice, however, and is effective. As a precautionary measure a suture should be put across the scrotal wound, because the fact of the descent of the omentum indicates the likelihood of a somewhat abnormal condition of the internal inguinal ring. The suture should be removed in one or two days' time.

If the descent of the omentum occurs sometime after the operation, the external part will be more or less congested and inflamed and is sure to be soiled. The amount prolapsed may vary considerably, and although some uneasiness may be exhibited by the animal very little systemic disturbance usually occurs. Treatment can, as a rule, be carried out with the animal standing. The scrotal region should be thoroughly cleansed and disinfected. The prolapsed portion is then dealt with in an exactly similar manner to that already described, being cut away well above the inflamed part. No suture need be inserted into the scrotal wound.

Prolapse of Bowel.—This is a much more serious condition. Here again prolapse may occur at the time of operating or shortly after. Violent pain very soon occurs, and the amount of protruding bowel—usually small intestine—is increased during the struggling and straining of the animal. Unless remedial measures are immediately applied the bowel rapidly becomes congested and changed in appearance; signs of shock and subsequent collapse soon become manifest, and death occurs in a few hours.

The animal must be secured in the dorsicumbent position and anæsthetized. Every endeavour must be made to protect the protruding bowel from soiling and injury, and to prevent further prolapse. The bowel is then cleansed thoroughly with some suitable antiseptic or preferably with warm sterile normal saline solution, if this is quickly procurable, and reduction carried out. The opening through the testicular tunics should then be secured, and after giving them one or two twists a strong wooden clamp placed as high as possible on them. The end of the spermatic cord should be included in the clamp if possible, as this helps to support the clamp and tissues in such a position as to prevent the descent of bowel into the vaginal sac. The animal should be kept quite quiet and prevented from struggling; an anodyne being given, if necessary. He should be fed on light diet and the scrotal region kept clean with antiseptics. If progress is maintained and no bowel is present in the vaginal sac the clamp may be removed in four or five days' time, or it may be allowed to fall off of its own accord.

If any tearing or much bruising of the prolapsed bowel occurs before attention can be given to it, the animal should be destroyed: such cases are invariably fatal.

Other sequelæ of castration are the results of various degrees of bacterial infection. Infection may occur at the time of operating or subsequently.

Septic Infection.—This can be looked upon only as a serious sequel of castration in proportion as the results of it are serious. Slight septic infection almost always occurs, even if only in the scrotal wounds. The normal peritoneum, of which the tunica vaginalis is, of course, an extension, is capable of dealing with slight infection, having a particularly good defence against bacterial invasion. The degree of septic invasion may range from infection of the scrotal wounds to infection of the spermatic cords and inguinal canals, and even extend to the abdominal cavity, setting up peritonitis; it depends upon the degree of infection, the virulence of the organism, and upon any factor that may tend to lower the vitality of the animal in general and the invaded tissues in particular, *e.g.* unhealthy condition of the animal at the time of operation, exposure, etc., handling of the spermatic cords and tunics at the time of operation, and the undue application thereto of antiseptics.

If the post-operative swelling is well forward and chiefly confined to the prepuce, if the discharge from the wounds is not excessive or offensive in odour, and if the animal is moving about freely and feeding, no attention to the wounds is necessary. But if the swelling is distinctly posteriorly situated in the scrotal region, the discharge copious and offensive, and the animal disinclined to move and off feed, he should be caught and the scrotum and thighs carefully cleansed, and the scrotal wounds syringed out with some suitable antiseptic and all accumulated discharge removed. Any of the commonly used antiseptics will do, but they must be properly prepared and of suitable strength, and clean utensils must be used. Care must be taken not to use too much force and that the fluid can escape easily, otherwise infective material may be forced higher up the canal and even into the abdominal cavity. If the fingers are introduced into the scrotal wound after they have been well cleansed and disinfected, the spermatic cord can be distinctly felt as a tumified mass extending upwards.

Abscess formation in the groin, just inside the flank, may occur. Under suitable local treatment, good feeding, and exercise, the majority of cases soon improve and complete recovery takes place.

In a small number of cases the condition may either become more acute, infection extending to the abdominal cavity and setting up peritonitis, or may assume a more chronic character, giving rise to the condition known as scirrhous cord.

Peritonitis.—This should be very infrequent.

The writer, deservedly or undeservedly, has yet to see his first case as a sequel to castration.

The condition is set up by septic invasion through the inguinal canal. The majority of cases in which the affection is definitely established prove fatal. The symptoms shown are: disinclination to move or eat, high temperature—up to 107° F.; fast thready pulse; short jerky thoracic respiration—a distinct pause between inspiration and expiration; dirty inflamed mucous membranes; and a dull, decidedly anxious, and pained countenance

Treatment, other than local antiseptic applications to the scrotal and inguinal regions, is given elsewhere, but is of little avail.

Scirrhous Cord.—It is necessary to distinguish under this heading a subacute circumscribed inflammatory condition limited to the extreme end of the divided spermatic cord from a much more chronic inflammatory condition having a tendency to extend up the cord and to the surrounding tissues. The former, to which the term granuloma of the spermatic cord might be applied, and to which the French term "champignon" is more applicable, owing to its quick growth, than to chronic scirrhous cord, occurs as a well-defined spongy mass of excessive granulations growing from the extreme end of the spermatic cord—sometimes under the scrotal integument, but more commonly externally to it. Growth is rapid and exuberant. As a rule, one cord only is affected, but cases do occur in which both are more or less equally affected. The size of the growth may vary from that of a large orange to two or three times that size. The condition may occur after any method of castration. The cord being divided too low down is a predisposing factor. In the writer's experience it has occurred more frequently in animals operated upon for scrotal or inguinal hernia by the covered method than in ordinary castrations.

The actual cause is probably an infection of the stump of the cord by some benign organism setting up a slight, prolonged, and persistent irritation. The condition is not serious and is easily cured by total excision—the mass being removed by division of the cord with the écraseur well above the inflammatory tissue.

Chronic Scirrhous Cord.—The commonly accepted cause of this is infection with a specific type of organism—botryomyces.

Infection may take place at the time of operation or subsequent to it. An especial feature of the condition is its chronic nature—its presence not being discovered or suspected until some considerable time after the operation. It may be ascertained on examination that in some cases the scrotal wound has never quite healed; while in others healing has been completed and the condition not become manifest till months or even years afterwards.

From the frequency with which the remains of the spermatic cord is affected it would appear that the original infection is at the end of this, but extension of the infection with induration of the surrounding tissues gradually occurs until the area of affected tissue is in some cases enormous. Extension occurs up the cord as far as the inguinal ring, and even subperitoneally beyond.

The external symptoms, and those generally first noticed, are intense induration of the scrotum with abscess formation. An abscess may form, burst, and heal, and the surrounding inflammation appear to subside temporarily only to be followed by further abscess formation. In older-standing cases there are multiple surface abscesses or open sinuses leading into the depth of the indurated mass. One or both cords may be affected. Occasionally one meets a case in which lameness or a certain degree of stiffness in movement of one or other of the hind limbs may be the first symptom noticeable. There is, as a rule, no marked systemic disturbance or loss of condition in the animal affected.

Treatment consists in removal of the affected tissues. The sooner the condition is diagnosed and the sooner operated upon after discovery the simpler is the operation and the quicker the cure.

The animal must be secured in the dorsicumbent position and an anæsthetic given. If the condition is only in the early stages entire removal of the affected tissues is comparatively easy, but if the condition is old-standing and the infiltration extensive the operation is a serious and always a bloody one. All, or as much as possible, of the affected tissue must be removed.

Blunt dissection, with the fingers and handle of a knife, should be employed, but sharp dissection will have to be done on some parts. Bleeding from large vessels must be controlled by forceps, torsion, and ligature. The large blood-vessels in this region must be avoided. If possible, one should endeavour to get to sound healthy tissue of the cord above the mass. This can be cut through with an écraseur, but unless quite healthy tissue can be reached the knife is necessary, for no ordinary écraseur chain will stand the strain owing to the fibrous nature of the tissue to be cut.

The operation should be of course performed under aseptic and antiseptic conditions. The cavity, after removal of the affected mass, should be dressed with strong tincture of iodine (1 in 8), and plugged with sterilized gauze. The wound afterwards should be dressed with suitable antiseptics.

The administration of potassium iodide and biniodide of mercury internally should accompany the local treatment.

Paraphimosis.—So-called paraphimosis sometimes occurs as a sequel to castration. It is seen following more or less serious infection of the spermatic cords or scrotum, where there has been pronounced inflammatory œdema of the surrounding tissues. It is not a true paraphimosis in that retraction of the penis is prevented, not by a constriction of the prepuce, but rather by the extension of the inflammatory œdema to the prepuce, to its secondary internal fold over the base of the free portion of the penis, and to the penis itself. This causes the penis to become straightened out and protruded from the prepuce. When this has occurred the added weight of the transudated fluids into the preputial and penile tissues acts as a greatly aggravating factor, causing the organ to become all the more pendulous and the circulation all the more difficult.

In some cases of so-called paraphimosis a true phimosis exists. It is caused by a great accumulation of œdematous fluid in the loose connective tissue of the secondary internal fold of the prepuce, resulting in this fold becoming protruded and so swollen and œdematous that the orifice at its free end is more or less closed, preventing the protrusion of the glans and free portion of the penis.

The condition may vary in severity, but under suitable treatment recovery usually takes place. Rarely, however, the condition is permanent even after the œdematous condition has subsided—a paralysis of the retractor penis muscle, resulting from a degeneration of its fibres, following a myositis set up at the time of the original inflammatory condition, or owing to the continued over-extension of them.

Treatment.—Besides the local treatment to the scrotal wounds already described, anything that will tend to lessen the further transudation of fluid and assist in the removal of that already accumulated should be carried out. In order to remove the aggravation due to the pendulousness of the organ, a bandage or sling should be adjusted so as to suspend the penis in line with the prepuce. An ordinary triangular bandage with three tapes, one from the apex up between the thighs past the root of the tail to meet the two from the other corners brought up by the flanks to tie across the loin, is never effective. The bandage—made of ordinary washing flannel or part of an old blanket—should be folded as follows:

Six tapes are adjusted: the posterior one passes up between the thighs past the root of the tail under the lateral ones, which are brought up by the flanks and tied across the loin, and tied to the top of a surcingle. The anterior one is tied to the bottom of the surcingle, and the two others to the top of it or at such a level at the sides as will maintain the bandage on the abdominal wall.

Massage, fomentation, and astringent lotions may be beneficial. Exercise is especially so. Scarification of the penis is adopted by many. This, by allowing expression or draining of the œdematous fluid, reduces the weight considerably and so far acts beneficially. It should be accompanied by suspension. There is, however, a possibility that aggravation may result from an added local infection of the tissues. It is not recommended in advanced cases when there is tumefaction and surface abrasion and exudation. Previously to its being done the surface of the penis should be always cleansed and disinfected.

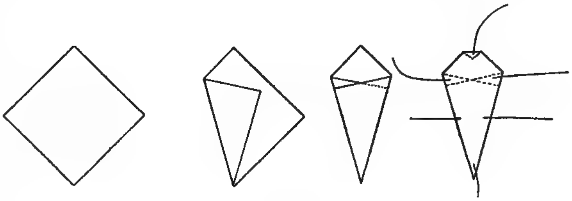


Fig. 307.

When paralysis of the penis has occurred the animal may be made workable by attempting a plastic operation. The instruments required for this are: A sharp scalpel, scissors, dressing-forceps, several pairs of artery forceps, medium-sized suture material and needles, a catheter or whalebone-sound, and a hank of broad tape. The animal may be secured in the dorsicumbent position or the laterocumbent with the upper hind leg fixed up as in castration, the penis and prepuce having been cleansed previously. The slinging bandage should be allowed to remain on during casting so as to prevent bruising or other injury to the organ. The tape is put on behind the glans in the form of a clove-hitch and the free ends tied. By this an assistant holds the penis extended. After the skin of the penis has been disinfected two incisions completely encircling the penis are made through the skin, one immediately below the prominent ridge of skin that forms the lower limit of the skin covering the base of the free portion of the penis, and the other some three or four inches above this close up to the opening into the sheath. These incisions should be made by gradually extending them alternately—not by completing one before commencing the other. They are then connected by a longitudinal incision; and by dissecting in one or both directions from this connecting incision, this band of skin, with its underlying œdematous connective tissue, which is of variable thickness, always greatest in front, is completely removed, care being taken not to damage any of the large blood-vessels external to the tunica albuginea. The now widely-separated edges of incised skin are approximated and held in position by interrupted sutures, dressed, and the animal allowed to rise. Suitable antiseptic and dry dressings are applied and the use of the suspensory bandage continued till healing is complete.

Failing this, amputation of the penis must be carried out.

Tetanus.—This as a sequel to castration is the result of infection by a specific organism—the tetanus bacillus. Although this may occur anywhere, it is noticeable that its occurrence is much more common in some localities and countries than in others. Several of a number of animals operated upon at one place or on one day becoming affected would point to some carelessness in regard to the cleanliness of the instruments or the operators' hands. But isolated cases may be due to accidental infection either at the time of operating or subsequently. In localities where tetanus is known to be common a dose of antitetanic serum should be given to the animal at the time of the operation. This may not act as a certain protection, but it will lessen the severity of the affection and render recovery more possible.

Castration of a Horse suffering from Inguinal or Scrotal Hernia

An animal suffering from either of these conditions, provided it is not subjected to repeated attacks of colic, nor shows any symptom of threatened strangulation, should not be castrated until two years old. Not only is there a tendency up to two years old for the hernia to become cured spontaneously or lessened in size, but all the animal's tissues, including those upon which one has to rely for effecting a cure, become stronger and more definitely developed; the operation is rendered easier, and better results are obtained.

Inguinal or scrotal hernia is by no means an uncommon lesion among horses, occurring perhaps more commonly among the coarser breeds. Scrotal hernia is present in quite a large number of foals at birth or soon afterwards. In a few the hernia assumes such proportions, or such symptoms are shown, that immediate surgical interference is necessary. In the majority, however, it has disappeared before the animal is one year old. If still present it is likely to be permanent, though it may become reduced in size.

Hereditary predisposition or inherited deformity is considered to be a cause in young stock. And although the evidence of the more frequent occurrence of the condition among foals of a certain sire or from a certain dam appears to substantiate this opinion, there are undoubtedly other predisposing factors. One such in the experience of the writer appears to be worth mentioning—and there must be others.

The condition was extremely common among the male colts bred at a certain stud. About fifteen colts was the average number for castration yearly, and among these two or three usually had to be left to the following year and specially operated upon. A larger proportion than this had suffered from the condition at or soon after birth. There was no pleasure in operating on animals at this place, but unpleasant as it was, confidence, however, in the reliability of careful preliminary examination of the scrotum was gained. The possibility of the stallion being to blame was considered, and since he was used almost solely for the owner's mares, there was no evidence to prove him guiltless. Following the purchase of another stallion, not on account of the other's possible deformity, but because his stock were coming round for service, the trouble continued. This stallion, however, was travelled in the district, and since it could not be ascertained that any number of his other foals were ruptured, closer investigation was made. As a result of this it was found that there appeared to be undue interference on the part of the man who looked after the foaling mares, the custom being to get help as soon as the mare showed signs of foaling, and forcibly draw the foal away —not being content with assisting the mother in her normal efforts.

It was reasoned that in delivery by traction there is a tendency for the whole abdominal contents to be forced into the posterior portion of the abdomen, especially so if dilatation of the vaginal passage is not yet complete; and with the foal in an unnaturally extended position there is the possibility of some part or other of the viscera being forced through one or both inguinal rings down the canal; whereas in delivery by propulsion—the normal method —directly opposite influences are at work. Whether this be the explanation or not, the trouble at this place ceased, following the strict forbiddance of unnecessary interference during normal delivery; and castration of colts for this owner could be undertaken without fear or trembling.

The extent of the condition may vary from a small knuckle of bowel or omentum which does not descend further than the inguinal canal, to a quite considerable amount descended into the vaginal sac; this, along with the overlying scrotum being distended and pendulous, reaching in some cases almost to the hocks. The sac, although distended, maintains its normal shape, being curved downwards and backwards and having at its extreme postero-inferior limit a definite hemispherical bulge, which normally accommodates the tail of the epididymis. The abnormality is usually unilateral—more frequently on the left side. It may, however, be bilateral.

The animal must be secured in the dorsi-cumbent position, some method being employed whereby the hind limbs are well flexed and held apart so as to allow free access to the scrotal and inguinal regions, similar to that required for " rig " operation.

A method which is a combination of that of Miles, described in Fleming's *Veterinary Surgery*, and of that of Donald, described in the *Journal of Comparative Pathology and Therapeutics*, vol. i. (p. 332), is particularly effective. A combined neck-rope and surcingle is used, which consists of a rope fourteen feet long, which has spliced into one end a metal ring two inches in diameter; four inches from this is a loop in the rope having a metal eye about one and a half inches in diameter. At a point fifteen inches further along the rope is a plain spliced loop in the rope, and another one similar some six inches from it, and again fifteen inches from this another loop having a metal eye in it similar to the other one. The rope is applied by passing the ringed end over the neck from the near side—it can be done from either side —and the free end passed through the ring, thus forming a loop round the neck. This loop is tightened so that it fits closely to the base of the neck just in front of the shoulders and in such a position that the two rope loops lie on either side of the middle line at the under side of the neck and in front of the chest, and the metalled eyes lie backwards over either scapular region. The rope is fixed by making a *bowline* knot with the ring. The free end is then passed round the chest behind the withers and elbows, and secured also in the form of a *bowline* knot. These knots can always be undone easily. This loop back from the collar and round the chest does away with the possibility of the neck loop slipping up the crest when the animal struggles.

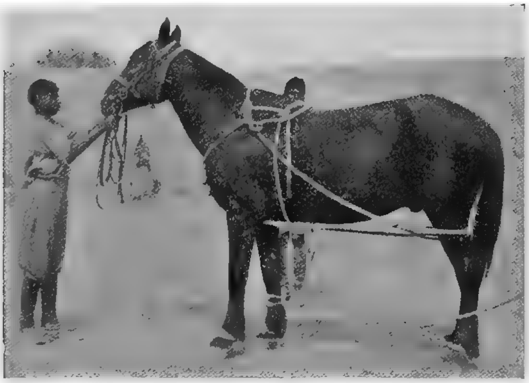


Fig. 308.—Method of casting and securing horse for hernia or rig operation. Rope adjusted ready for casting.

Two side-lines, each twenty-five feet long, and having a spliced loop at one end, are fixed on to the bottom loops of the collar by passing the loop of the line over the loop of the collar and then threading the free end of the line through the latter. The benefit derived from these separate loops on the bottom of the neck collar is that the collar maintains a better position and does not draw to one side, causing pressure across the bottom of the windpipe and blood-vessels, as happens when the collar is improvised out of the combined side-lines and when the side-lines leave the neck loop at its lower middle point. The side-lines may be attached to the neck-rope before this is placed in position, or afterwards, whichever seems the more convenient. The two side-lines are then passed backwards, quite free of one another, between the fore and hind limbs, each one being brought round the back of the thigh outwards to its own side, from where they pass forwards through the metal eyes on the neck-rope, on the way being looped once round itself in front of the stifle. The near side-rope is then passed over the back to the off-side, where it is held along with the fellow off-side rope sufficiently taut to prevent their slipping below the hocks.

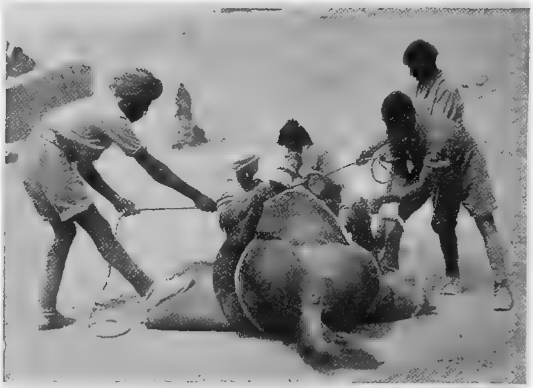


Fig. 309.—Method of casting and securing horse for hernia or rig operation.

Four webbing hobbles with metal D's and a fifteen-foot rope with a spliced loop at one end are used for casting. A hobble is placed on the near fore pastern, one on each of the hind pasterns, and the fourth on the cannon of the off fore limb. The looped end of the shackle rope is put round the off fore limb, threaded and pulled up tight on the pastern; the free end is passed through the D of the hobble on the near fore from off-side to near side, across to the off-side and then to the near side through the D's of the hobbles on the hind limbs. From here it again crosses to the off-side to be passed through the D of the hobble on the off fore back again to the near side, when it is held by three good men. If the hind limbs are very straggling they are brought together in a more forward position and any slack in the shackle-rope taken up. The operator then goes to the off-side, where, with the man already holding the side-lines, they will use the near side one, which has been passed over the back, as a "pull-over" rope. The man at the animal's head, which he should be holding with a hand on each side of the bit or head-stall, or by the twitch if it has been necessary to apply one, should, on the signal being given to pull, give the animal's head a sharp push upwards and backwards.

The advantage of the hobble on the fore limb of the side on which the animal is to fall being the last the shackle-rope passes through, does not appear to be sufficiently widely appreciated. Taking the near hind pastern as a fixed point, the primary effect of the pull on the shackle-rope to the near side is for the D of the hobble below the knee on the off fore limb to act as a pulley and this limb to be pulled in under the body, which is then easily thrown out of equilibrium. It is undoubtedly due to this fact that animals cast in this manner appear to go down very easily.

When the animal is on the ground the four feet are pulled together and secured by making a double hitch with the shackle-rope round the near hind pastern. The animal is then anæsthetized. In order to save time the securing of the animal in the proper position for operating may be proceeded with before the surgical stage of anæsthesia has been reached. The loop of the side-line above the near hock is placed below the fetlock and the rope drawn taut and securely held. The shackle-rope is freed from the near hind pastern and unthreaded from the hobbles on the off fore and near hind limbs, and is again given a half hitch on the near fore pastern. The two freed hobbles are removed. The near side-line is now tightened slightly, and at the same time the operator, standing behind the croup, reaches over and grasps the cannon of the near hind limb with his left hand, and by pulling in a line with the croup flexes the limb so that the foot is just in front of the stifle. The side-line is tightened with the foot in this position, but not so as to pull the foot too far forward. To secure the foot at this length a couple of hitches of the line coming from the collar eye are placed over the foot in such a way that they form a clove-hitch round the pastern.

The estimating of the correct position of the foot is a matter of a little experience. If the foot is drawn too near to the collar the back of the animal, when he is finally secured, will be arched and the hind leg in a position that will not allow of the freest access to the inguinal region. If there is too great a length of side-line between the collar and the foot then there will be too much play of the limb, and other parts of the securing will be thereby affected.

The free end of the side-line coming from where it is hitched round the near hind pastern is now passed in from behind between the lower quarter and the ground so that it is in front of the angle of the haunch. It is pulled taut, its direction being up the near flank and across the back just in front of the croup. The animal is now turned on to its near side by means of the shackle-rope. The off side-line is passed down into the heel and tightened, the shackle-rope being released and unthreaded from the hobble on the off hind limb, and the hobble removed. The fore limbs are now secured by flexing the knees, and by passing the shackle-rope under the near forearm round the front of it, high up towards the shoulder, from where a loop in it is passed between both forearms and passed over the near fore foot; this loop is tightened by pulling on the free end, which is passed round the front of the off forearm, which is uppermost, across the outside of it to be hitched round the off fore pastern. The off side-line is now fixed and passed under the croup to the near side in exactly the same manner as the near side one was dealt with. The rope from the near hind foot is now pulled on so that the foot is drawn up close to the flank. The operator takes this rope and passes it across the off quarter and gaskin so that it gains the inner side of the limb, crossing the inside of the tibia and round in front of the off pastern, above the rope coming to the off pastern from the collar. It is pulled backwards as tight as possible and secured by making a couple of hitches round the pastern. By this means the near hind limb is held flexed and the off hind prevented from being thrust forward. The animal is now rolled on to its back and maintained in that position by placing on each side a sack stuffed, not too tightly, with straw or sawdust. The rope from the off hind foot is held securely meanwhile, and then fixed on the near hind pastern similarly to that on the off hind.

By securing the animal in this manner there are no ropes crossing the scrotal region as there are in Miles's method; neither is there any need for using a spreader, rather the reverse. A small cord can be passed from one hind foot to the other to prevent any overspreading of the hind limbs.

Although the securing occupies a little time, this is not time lost, for it can be completed almost as soon as the animal has reached the surgical stage of anæsthesia. Any exertion on the part of the operator in doing it is repaid him a hundredfold when it comes to operating. Especially is this true when he has no professional assistance, as is generally the case in the country.

To release the animal the side-lines are untied from both hind pasterns and pulled out from under the croup. Then, according to which side the animal is intended to lie on, the clove-hitch on the pastern on that side is removed, the sacks taken away, and the animal allowed to roll on to that side. The fore feet are now released, the shackle-rope taken off the off fore pastern and withdrawn from the hobble on the near fore and removed. The bottom side-line is slackened and removed from the pastern. The upper one is now released and removed; and lastly the combined surcingle and neck-rope is untied and the animal allowed to rise.

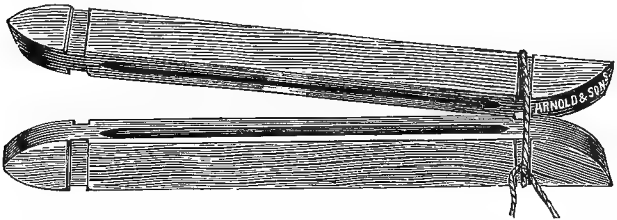


Fig. 310.—Wooden castration clamp.

Instruments.—A sharp scalpel, two or three wooden clamps, the ordinary strong, grooved, straight, wooden clamps (Fig. 310), a pair of strong forceps for closing them, and strong cord for securing them. An écraseur, right and left hernia needles, one or two ordinary strong suture needles and silk, a few pairs of artery forceps, scissors, and dressing-forceps. All instruments should be sterilized by boiling just previous to operating. They can be used direct from the sterilizer; or, considering the environment in which the operation is usually performed, it is as well for them to be immersed in a suitable antiseptic solution in an enamel tray. Just as with regard to attention to detail of securing, so attention to detail in endeavouring to obtain aseptic and antiseptic conditions throughout is well repaid by results.

Preparation.—The animal should be restricted to a non-bulky nutritive diet for a short period, and suitable exercise allowed. It should also be taught to stand tied up, if this has not already been done. The sheath should be cleaned three or four days before operating, and if possible, the hind legs and feet well cleaned the morning of the operation. The hind feet should be wrapped in damp cloths when the animal is secured, in order to prevent dirt soiling the wounds if the animal should struggle.

Food should be entirely withheld for at least twenty-four hours previous to the operation, a small quantity of water only being allowed.

When the animal is finally secured the scrotal and inguinal regions and the inside of the thighs are well sprayed, or painted, with tincture of iodine.

Operation.—The animal should be inclined a little to the side opposite to that affected, or if the condition is bilateral, then to that chosen to be operated upon first.

In many cases the hernia has become reduced spontaneously, owing to the position of the animal and to the anæsthetic. Whether this is so or not, the first thing for the operator to do is to secure the testicle. The incising of the scrotum and laying bare of the underlying tissues is greatly simplified if the testicle is present. Occasionally it will recede into the abdominal cavity along with the intestine, but even if this has occurred the testicle may be secured by exercising a little patience. The thumb and fingers of one hand should be thrust in the direction of the external inguinal ring and the fingers of the other hand thrust into the deep inguinal region and used as directors. Moving the animal slightly from side to side will often cause the testicle to float up into the scrotum. If the operator has an assistant he can, after well soaping or oiling a hand and arm, insert it into the rectum and endeavour to locate the testicle and direct it towards the operator's hands. The operator should not do this himself, as it is quite out of the question for him to render surgically clean again at the time the hand and arm he has so used.

If the hernia has not become reduced the testicle will almost certainly be present, and there will be no difficulty in securing it. This having been done, the hernia is reduced by careful and definite manipulation. As a rule this is easily accomplished in young animals, adhesions being rare. Adhesions are more likely to follow a hernia occurring in an older animal as the result of accident, a primary inflammatory process having been set up. If, however, reduction cannot be accomplished thus, intra-abdominal traction on the bowel may be practised by an assistant with a hand and arm inserted into the rectum. Failing this, opening of the testicular tunics at a later stage of the operation will be necessary, and any adhesions will have to be broken down, and possibly the internal inguinal ring enlarged.

The testicle covered by the scrotum is lifted as high as possible by the right hand; the left grasps securely the scrotum and enclosed spermatic cord below the testicle, and by exerting a squeezing action renders the scrotum over the testicle very tense. An incision, four or five inches long, either parallel to the scrotal raphe and a couple of inches from it, or from the direction of the inguinal region backwards and inwards to the scrotal raphe, is carefully made through the scrotal integument *only*. The squeezing action of the left hand—as though trying to bulge the testicle out of the opening—is maintained, and is very necessary. The underlying tunic, the dartos, is cut through by a succession of short shallow cuts the whole length of the incision: the sharper the scalpel is, the less likelihood of cutting too deep. Cutting is continued to such a depth that the edges of the incision begin to separate, and the underlying testicle covered by its tunics to bulge out, under the pressure exerted by the left hand. It will be seen that the yellowish-red tissue of the dartos has been completely severed before this happens, and the transversely crossing, white, glistening, fine fibres of the underlying tunics can be made out.

It is quite immaterial as to exactly what tissue has been or is necessary to be cut under the dartos. For when once the bulging of the testicle has started freely for the whole length of the incision the knife can be laid aside and the further enucleation of the testicle in its tunics completed by separation by the thumb and fingers only, first of the right hand and then of the left. By this means little or no hæmorrhage will occur; and there is no fear of opening the tunics. A definite attachment, however, through which it is necessary to cut with the knife, exists in the form of the scrotal ligament from the postero-inferior extremity of the tunics toward the perineal region of the scrotum.

The vaginal sac is liberated as high up as possible. If the bowel has again descended, the hernia is finally reduced. The testicle in its sac, held high by the right hand, is given one complete twist. This not only prevents any further descent of the bowel while the clamp is being put in position, but assists in maintaining it in position after the clamp is applied. The clamp is put on from four to six inches above the testicle and pushed well home on the cord and tunics. The open end of the clamp is closed by the thumb and index finger of the left hand, and the right, having released its hold of the testicle, applies the steel forceps to the clamp between the point where the spermatic cord passes through it and the encircling groove for the securing cord. The clamp is then slowly and firmly closed by exerting pressure with the forceps, which an assistant then holds firmly while the operator ties the clamp securely with strong cord.

It is not necessary, in fact it is not advisable, to place the clamp as high as possible on the cord. It must be remembered that as a result of the position of the animal and the consequent sinking in of the abdominal wall the inguinal canal is considerably shortened. By pulling on the vaginal sac when this is exposed the canal can be made to be practically non-existent. If then the clamp is put on as high as possible, the downward pressure upon it consequent upon the animal rising and the abdominal wall resuming its normal position will place such a strain upon the vaginal sac and cord in the region of the internal inguinal ring that tearing of either, followed by escape of intestine, may result. Even if this tearing does not happen, the pressure of the clamp on the scrotum will cause necrosis of the skin, followed by granulation, a condition which will aggravate the local inflammatory swelling, which always occurs to a greater or less extent, and may render the removal of the clamp somewhat difficult.

If the clamp is put well above the testicle and epididymis it will be held up in the inguinal region firmly enough when the animal is on its feet, and will prevent any re-descent of the hernia, which will be cured as well as the animal castrated.

In cases where the testicle is very big it should be removed, so as to lessen the drag on the cord. This is done, after the clamp has been securely adjusted, by making an incision through the tunics large enough to liberate the testicle, which is removed with the écraseur. This part of the operation should be performed under the strictest antiseptic conditions, and the opening in the tunics closely sutured after removal of the testicle as a precautionary measure in case of any accident to the clamp.

In operating upon a case in which the hernia is irreducible on account of the existence of adhesions, the tunics containing the testicle and the herniated viscus are carefully exposed and freed in a similar manner to that already described. An opening large enough to admit one finger is made at the bottom of the sac and the adhesions between the bowel and tunic carefully broken down and the hernia reduced. If this does not succeed, then the vaginal sac must be laid open sufficiently to enable reduction to be accomplished. By temporarily suturing the tunics over the testicle again a much better purchase is obtained on the tunics and the operation is completed in the same manner as when the tunics are not opened. Needless to say, every precaution must be taken to prevent infection of the vaginal sac and consequent peritonitis.

The clamp is allowed to remain on for five or six days, when it is removed, or it may be allowed to drop off of its own accord.

The other testicle is treated in the same manner if a hernia, or any suspicion of one, exists on that side. If not, the testicle can be exposed in the ordinary manner and removed with the écraseur.

In those cases in which the hernia has been a very large one, or in which there may be any doubt of the tunics standing the strain, the clamp may be placed inside the scrotal incision and the lips of the wound brought together over it by interrupted sutures. If satisfactory progress is maintained the clamp is allowed to remain in position for about a week, when it is removed. In those cases, however, in which it is thought advisable, one or two of the sutures in the scrotum should be removed two or three days after the operation. It should be rarely necessary to have to resort to this covering up of the clamp.

The animal should be released in such a manner that he is lying on the side on which the hernia existed, and he should have quite recovered from the anæsthetic before being allowed to rise.

After-treatment consists in placing the animal in a clean stable and tying it up so that it cannot lie down. The food should be restricted and light for a few days, and then, if progress is satisfactory, an increased quantity of a more normal diet, containing some corn, may be given. The animal may also be untied so as to be able to move about and get some slight exercise.

Very little in the way of really effective dressing of the scrotal region can be accomplished, nor does it appear to be necessary. Attention should be paid to the cleanliness of the surroundings. If flies are at all troublesome, spraying of the scrotal region with 2½ per cent carbolic acid or 1 per cent lysol, followed by dusting on boric acid, may be carried out two or three times daily.

Castration of the Donkey and the Mule

The male donkey and male mule are castrated by the same methods as those which are employed in the horse. These animals are usually operated upon in the recumbent position.

Although the testicles of the donkey are comparatively larger than those of the horse, the tissues composing the spermatic cord appear to be of thinner structure and are more friable. No matter by what method, or how carefully, the operation is performed, a variable amount of hæmorrhage usually occurs immediately following the operation, especially in adult animals. This hæmorrhage should cause no alarm, because it will almost invariably cease spontaneously.

The testicular sacs of the mule show a much greater tendency to persist after castration than do those of the horse, in which they usually become obliterated by becoming adherent to the spermatic cord and the whole structure atrophying.

Fluid accumulates in these non-obliterated sacs, giving the animal the appearance of not having been castrated, or of being ruptured.

The precise cause of this phenomenon, however, in the mule is somewhat doubtful. Generally speaking, the tissues of the mule are without doubt more resistant to, or are more capable of dealing with, infection by pyogenic bacteria. A possible explanation, therefore, of this persistence of the testicular sacs is that there is less local inflammatory reaction following castration in a greater proportion of mules than horses, and a correspondingly proportional number of cases in mules in which adhesion of the parietal and visceral layers of the tunica vaginalis, resulting in obliteration of the sac, does not take place.

In order to lessen the occurrence of this condition the lower part of the testicular sac should be removed along with the testicle at the time of castrating.

When it has occurred the only effective remedy is removal of the sac. The animal is cast and secured as for a scirrhous cord or hernia operation. An elliptical incision is made round the cicatrix in the scrotal integument and the sac dissected out. Sharp dissection with the knife will be necessary at first, in order to expose the tunics of which the sac is composed, then blunt dissection with the thumb and fingers will be possible. The sac when it has been freely exposed, and the remains of the spermatic cord which it contains, are removed high up by an emasculator or écraseur.

Castration of Cattle

The bull is usually castrated at the age of from two to eight months. Often, however, animals up to two years old are castrated—animals that have not developed up to the desired standard, or are otherwise unfit for breeding purposes. Occasionally older animals are castrated, but more frequently these are sold for slaughter uncastrated.

There is no particular season of the year much more favourable for the operation than another. The same remarks that were made in connection with the horse are applicable to cattle. The fact that the majority of these operations are performed in summer and autumn is governed chiefly by the time of the year at which the majority of animals are born.

An animal that is going to be castrated should be kept short of food for some hours previously. He should be in good health and placed in clean, healthy surroundings.

Restraint. — This varies according as to whether the animal is operated upon in the standing or recumbent position.

To secure an animal in the standing position a stall is the best place in which to have the animal. It is stood with its right side alongside a wall or partition and secured by means of a rope noosed round the horns or by a long shank from a suitable strongly made headstall. The rope is passed through a ring low down on the manger or head post and secured to another ring or post some four or five feet away. This precaution should be taken so that the rope may be released in the event of the animal throwing himself down in an awkward position. A pair of bulldogs, with a few feet of cord attached, may be applied to the nose, but if the animal's head is pulled well down these are not necessary. The end of the tail is passed forward between the thighs and to the left of the scrotum out by the left flank, where it is securely held by a man standing on that side of the animal pressing it against the wall. The operator stands directly behind the animal.

To secure the animal in the recumbent position, animals that are not too big can be cast as follows: Whoever is going to put the animal down seizes its right ear with his right hand and the narrow part of the lower jaw with his left, the thumb passing through the mouth behind the incisors and the fingers round under the jaw. He stands facing the same way as the animal, then by turning himself half round, and at the same time forcing his left hand up and pulling his right down, he twists the animal's head and neck and it falls easily on to its left side. It is then held by the man placing his left knee on its neck close behind the ear, and, having leant forward and grasped the right hind leg, pulling this up and holding it well pressed down on to the ribs by both hands, one above and one below the hock. If the animal is fairly large the leg is held by another man, or it may be secured by a short cord, which is tied on to the cannon, passed round under the neck over the withers, then under and round the leg above the hock, where it may be secured or the free end held.

To cast an adult animal a side line, which may be used in various ways, is necessary, or the animal may be cast with hobbles placed above the fetlocks, or by Reuff's method, a neck rope being used to secure the right hind limb.

The recumbent position is preferable for the young animal, since it can be so easily cast, and more easily held and dealt with than when standing. In larger and older animals the standing or recumbent position is a matter of choice for the operator.

The more commonly employed methods include: the use of Burdizzo's emasculator, and various other patterns of emasculator, which are usually made a size smaller than those for the horse; the écraseur; ligation; a method of combined torsion and tearing; and the actual cautery; all of which methods—even the last—can be carried out upon the animal in either the standing or recumbent position. Another method employed, though not in this country, is subcutaneous torsion, bistournage; and yet others: crushing of the testicles, and ligation of the neck of the scrotum, either with cord or with an elastic band.

Whatever method is adopted, the same attention to sterilization and disinfection of instruments and cleanliness of the operator's hands is as necessary as in the case of castration of equines.

The quickest, easiest, cleanest, and safest method for all ages is, without doubt, the employment of Burdizzo's emasculator, Fig. 311. The efficacy of this instrument depends upon its being jointed in such a manner that great pressure is exerted at the jaws by the application of comparatively small force at the handles. The jaws are made so heavily and strongly that no pressure is lost by springing of the jaws, which are also wide, rounded transversely on the edges, and quite smooth. The edges of the jaws come together so intimately when the instrument is closed that any tissue interposed between them is completely crushed. In action they embody a perfection of Siebold's method, in which a screw clamp is used to crush the neck of the scrotum and the included spermatic cords.

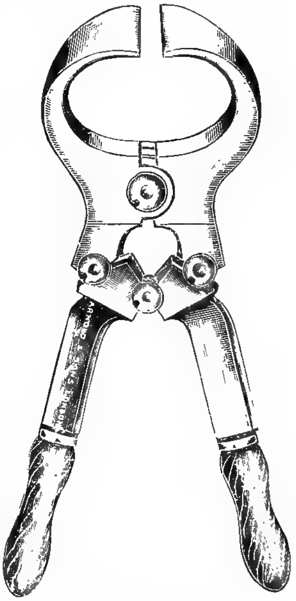


FIG. 311.
Burdizzo's emasculator.

Precision in their use is necessary. The instrument lends itself admirably for use in the standing position, but is of course equally applicable for the recumbent position. The operator standing behind the animal grasps with his right hand the right testicle, in the overlying scrotum, at its junction with the spermatic cord, and draws the gland downwards to its full extent. The thumb and index finger of the left hand are put round the neck of the scrotum from left to right, and being approximated at about the middle line they push the right spermatic cord in front of them towards the right side of the neck of the scrotum, against which they firmly squeeze it. The thumb and index finger of the right hand are now moved into a position about two inches lower down than those of the left hand, and here they too squeeze the spermatic cord up to the right side of the scrotum, the remaining fingers and the palm of the right hand maintaining a hold on the testicle. An assistant then places the jaws of the instrument across that part of the right side of the neck of the scrotum between the thumbs of the operator, leaving about one inch of the width of the jaws overhanging the side of the scrotum. He then completely closes the instrument and opens it again immediately. A second crushing is made in precisely the same manner about an inch and a half or two inches lower down, the operator lowering his hands this distance and holding the cord as before. He then reverses the position of his hands and the left testicle is dealt with similarly.

The second crushing of the cord is by no means necessary, but it is painless and very quickly done and renders the obliteration of the testicular function absolutely certain. A possible explanation of the incomplete success, in a number at least, of a small percentage of cases in which the instrument has been applied to each cord once only, is that the cords were improperly held and so were incompletely crushed. There is a tendency for them to roll away from the jaws of the instrument unless held as described.

No after-treatment is necessary. The testicles and scrotum are swollen for a day or two, but the animal exhibits no systemic disturbance or any inconvenience whatever. The swelling soon disappears and the testicles become atrophied.

In other methods the testicle is exposed by incising the scrotum. This is done by grasping the testicle at its upper extremity with the left hand, and by exerting a downward pull upon it so as to render the scrotal skin and tunics tense over the gland. These are then freely incised along the whole length of the gland. As the testicle escapes the left hand releases its hold on the scrotum, but maintains it on the testicle, which is pulled downwards, causing it to take a horizontal position compared with its normal vertical one. As a result of this the spermatic cord spreads out. The knife is passed through the cord close to the vascular portion some two or three inches above the testicle, and the vas deferens and non-vascular portion of the cord is cut through. The vascular portion is freely exposed to above the pampiniform plexus, where it is severed by an emasculator or écraseur, or by the actual cautery, or by the knife after applying a ligature, the ends of which should be left fairly long. In young animals the cord may be twisted some five or six times after it has been freely exposed and freed from any accompanying fat, and then either scraped through with the knife or broken across the edge of it.

Some operators, who use the emasculator, écraseur, or actual cautery, liberate both testicles and then remove them at the same time. Any advantage gained—which is problematical—is nullified by the greater risk of infection as a result of the ends of the cords coming in contact with the outside of the scrotum.

Castration of Sheep

Nearly all males of this species are castrated when from one week to one month old. They are done in batches irrespective of their age between those limits. They are generally docked at the same time, and since this is done by simply cutting off the tail and making no attempt to arrest the bleeding the operation is performed at an early age. The time of the year at which young animals are operated upon is solely dependent upon the time at which they are lambed, a few days of promising weather being chosen. Weather that is wet and cold, and in which there is a north-east wind, should be avoided if possible, as should also very hot sultry weather in which there is a likelihood of the animals being "struck" by fly. Lambs bred for the early market and born at, or soon after, Christmas are usually left uncastrated and undocked.

Lambs should be separated from the ewes and penned so that they can be easily caught. An assistant holds the lamb by seizing a fore and hind limb of the same side in each hand and then pressing its back, tail downwards, against the side of his chest and in front of his shoulder; or the lamb may be held by the assistant grasping a hind leg in each hand with its back towards him and then swinging its head between his thighs and holding it there. The latter is the better position, for by allowing its hind legs to come to the ground while still maintaining the grip on its head the lamb is in the right position for docking. The animal should not be put back with the others awaiting operation, but turned loose into a grass field, where it will probably lie down for a few minutes.

Since the operation is nearly always carried out by the shepherd, some of the methods adopted are necessarily simple and crude in the extreme, and though carried out without any pretence whatever to surgical cleanliness they appear, judging by results, to be eminently satisfactory for dealing with the large numbers that are operated upon, several hundreds in the day being quite commonly disposed of. Occasionally a more or less severe loss will occur, which would appear to be directly due to this uncleanliness: such, for example, as the occurrence of a large number of cases of tetanus among one particular batch, and none among another batch castrated at the same place and in the same manner.

One is left wondering on hearing that there were no losses among a large number of lambs that one has seen operated upon, the shepherd, between about every third lamb, sharpening his knife on his dirty boots and leggings, covered with the dried-on placental fluid and blood and other filth, and laying his knife down on the ground between each operation in order to lift the lamb out of the pen while his assistant caught another one.

Operation.—The operator seizes the tip of the scrotum and with one cut removes about three-quarters of an inch of it. Each testicle covered by its tunics is pressed out, the tunic incised, and the testicle removed either by an emasculator or a pair of special torsion forceps, or it may be removed in the same way as described for calves, by giving several turns to the testicle and cord and then scraping through the cord with the knife or breaking the cord over the edge of it.

A common method followed by shepherds is, after removing the end of the scrotum, to seize the testicle with the teeth, either covered by its tunics or after these have been laid open, and draw the testicle away, allowing the cord to break where it will.

The lamb is then allowed to stand on the ground and its tail grasped by the left hand, the index finger of which is used to guide the blade of the knife under the tail to a joint at about the position it is desired to sever the tail. The tail is removed by a sharp upward cut with the knife, which should have a straight blade of about three inches long.

Castration of the adult sheep has always been looked upon as a most unsatisfactory operation, with a high rate of mortality, no matter what method of performing the operation is employed.

In any method in which the scrotum is opened there is a great risk of infection of the scrotal wounds, on account of the size and position of the scrotum, rendering it prone to contamination from the ground. Apart from this, however, quite a considerable percentage of the animals would appear to die not so much from infection as from intention. They will lie down after the operation and make no further effort to live.

As a result of this high degree of mortality many different methods of performing the operation have been tried, and among those methods that have been the most successful are those that would appear to be the most barbarous. Ligation of the neck of the scrotum, causing sloughing of the whole scrotum and testicles, is one such. The same object has been attained by putting on a clamp in the same position and leaving it on for about six days, when the scrotum and its contents are cut away and the clamp removed.

There is one method that stands out alone as regards its successfulness, namely, the use of Burdizzo's emasculator. The ram is "turned" on to his buttocks and the fore and hind limbs of the same side tied together. The wool is cut away from the neck of the scrotum, which is then painted with tincture of iodine. The instrument is then employed in exactly the same manner as that already described for cattle. After release the animal will lie down for a few minutes, but will soon get up and show no more ill effects.

Other methods may be employed: the covered operation, in which the scrotum only is opened and a clamp put on the cord over the tunics. The caustic clamp and the actual cautery are employed with varying degrees of success.

The Goat.—The male goat is castrated similarly to the sheep.

Castration of the Boar

The young male pig is castrated when from five to eight weeks old. The best time is a week or so before it is weaned, as its general health is probably better maintained than if castrated just after being weaned, at which time there is a tendency for the young animal to lose condition. Food should be withheld for some hours before the operation.

An assistant holds the pig by its hind legs grasped above the hocks, one in each hand, the pig's belly towards him. He then swings the fore part of the animal between his knees, where he holds it firmly. The back of the pig will thus be towards the operator, who stands directly in front of his assistant.

There is no well-defined scrotum in the young pig, the testicles in their separate sacs causing a bulging only of the perineal region. For this reason it is practically impossible to grasp the testicle and freely incise its coverings as in all other domesticated mammals. However, by using the last three fingers of the left hand to guide the testicle from between the animal's thighs to the perineal region, the thumb and index finger can render tense the skin over the gland. Then by a short, deep incision the testicle can be freely exposed. As it escapes from the opening it is grasped by the thumb and index finger of the left hand, and drawn clear of the incision; the posterior or cremasteric portion of the cord is divided by passing the knife through the double layer of the tunica vaginalis propria just behind the vascular portion of the cord and in front of the vas deferens, and cutting backwards. Slight traction is then put on the testicle, the edge of the knife reversed, and the vascular portion of the cord broken across its edge. Several twists may have been given to the cord before breaking it, but this is not really necessary in the very young animal, although it may be advisable to do it in those over two months old. The vascular portion of the spermatic cord of the pig is more friable than that of any of the other domesticated mammals. The second testicle is removed in a similar manner.

The absence of any well-defined scrotum in this animal, and the underlying fat that has to be cut through, render the use of a knife with a well-rounded cutting edge a necessity, if the making of an excessively long opening is to be avoided. The incision made as described will have a posterior rather than an inferior position when the pig is standing on the ground, and will be less likely to become soiled. In making the incision, however, the testicle should not be pressed too near to the anus, otherwise, should infection occur and the formation of pus result, this will be held in a pocket and will not escape freely. After being operated upon the young pigs should be put in clean surroundings, and not allowed to run loose in a manure yard. No attention to the operation wounds is, as a rule, necessary. If, however, there should be much swelling at the seat of operation, and the animal appear ill, then it must be caught and the usual opening, cleansing, and disinfecting of the operation wounds carried out.

Scrotal hernia is by no means uncommon in young pigs. It is thought to be caused chiefly by the sow overlaying them in small sties. In order to prevent this a rail about a foot or so from the ground is fixed round the walls of the sty.

To castrate a young pig suffering from scrotal hernia the following method is as successful as any. The animal is held as already described and the hernia reduced. Then, if a unilateral hernia only is present, the testicle on the sound side is first removed and the other testicle brought into position behind the existing external wound. An incision is made through the scrotal septum only sufficiently large to enable the testicle to be squeezed through. This testicle is then removed in the usual manner, and two or three sutures inserted into the external wound. If a hernia exists on both sides castration may be performed in the ordinary manner after reduction has been carried out, followed by suturing of both external wounds, or the operation as described for unilateral hernia may be carried out.

Orchitis is not infrequently met with in the pig. It is often mistaken for scrotal hernia while the pig is running loose, but digital examination of the swelling with the pig held in the ordinary manner as for castration renders definite diagnosis easy. The swelling is firm and irreducible. Adhesions between the gland and the tunics usually exist, but these are easily broken down after the tunics have been incised, and although a varicose condition of the veins in the cord is generally present removal of the testicle is safely effected by torsion and fraying of the cord ; no suturing of the scrotum is necessary. It is probable that the condition is more often the result of injury than disease.

In dealing with adult animals and those that have become too big to be held by hand some method of restraint is necessary. Several methods are employed. The use of a small set of side-lines similar to those used for horses is probably the best. The animal is first caught by applying a rope to the upper jaw behind the tusks in the form of a running, quick-release loop.

The side-lines consist of a neck strap having a ring on either side and two ropes leading from the lower part. Each rope is passed between the fore-legs and through a hobble on the cannon of the hind limb and then through the ring of the neck strap on its own side. The animal is cast and secured on its left side in the same manner as a horse. Several other methods of fixing the animal are employed. One method is to fix him in a standing position with his right side next to some strong rails. He is caught as before, and his head pulled high on to the rails so that a great part of the weight of the fore part of his body is taken on the cord, which is securely fastened. Another cord is put round his body at the flanks and made secure to the rails. The operation is performed with the animal in the standing position. In whatever way the animal is fixed the scrotal area is cleansed and disinfected. The testicle is exposed by incising the scrotum somewhat posteriorly, and is then removed either by an emasculator, by the écraseur, or by the actual cautery. Before releasing the animal it should be ascertained that no hæmorrhage is taking place, and any accumulated blood-clot should be removed. After-treatment is the same as for all animals.

Castration of the Dog

Castration is occasionally performed upon the dog at the request of an owner in order to check, sometimes natural, sometimes unnatural, habits. Probably, however, its performance is dictated more frequently by surgical needs than by sexual deeds.

The exposed position of the testicles and the means of offence in this species render the testicles more liable to injuries which may necessitate their removal. Tumours of the testicles are by no means infrequent in the dog. Chronic prostatitis, too, for checking or alleviating which castration is the most effectual line of treatment, is quite common in this animal.

A general anæsthetic—morphia followed by chloroform being the most suitable—must always be given if an aseptic operation is to be performed. An aseptic operation is easily secured in this species, and very much better subsequent conditions can be obtained than in any of the larger domesticated animals.

The instruments required include a scalpel, dressing forceps, scissors, several pairs of artery forceps, and fine suture needles and silk. These must be sterilized by boiling at the time of operating, and they should be used direct from the sterilizer.

The animal is fixed on an operating table in the dorsi-recumbent position. The hair on the scrotum and any long hair in its immediate neighbourhood is removed with scissors, and the whole area painted with tincture of iodine. A piece of sterilized calico or lint large enough to cover the abdomen, thighs, and perineal region, and having a small circular hole through it only large enough to expose the scrotum, is placed in position and tucked in under the animal's back. The scrotum is again painted with tincture of iodine, and meanwhile the operator has thoroughly cleansed his hands. A final rinsing in absolute alcohol causes no inconvenience whatever, and is very efficient in rendering them aseptic.

The scrotum and tunics overlying one of the testicles are incised, and the gland laid bare. The posterior non-vascular portion of the cord, excluding the vas deferens, is severed with the scissors. The vas deferens is then drawn tight, and a fine suture put on it as high up as possible, and the duct severed close up to the suture. Lastly the anterior vascular portion of the cord is securely ligatured high up and severed, leaving only sufficient of the cord to prevent the ligature from slipping. Any blood-clot is now removed from the vaginal sac and scrotum, and if there is still any hæmorrhage from them it must be arrested before closure of the external wound. The edges of the wound through the scrotum are brought together by closely placed, interrupted sutures, very fine needles and silk being used. In closing external wounds situated in positions in which there is little or no tension on the skin, the finer the needles and silk used the better will be the results obtained. There is less chance of infection, and consequently fewer sloughing sutures.

The other testicle is dealt with similarly. The scrotal skin is mopped clean and dried by being painted with alcohol, after which it is painted with Friar's Balsam (compound tincture of benzoin). One or two single layers of fine gauze large enough to cover the scrotum are then applied, and painted over with Friar's Balsam. A pad of gauze and cotton-wool is fixed in position by a bandage, the anterior tails of which are fixed round the loin and the posterior tails brought up one on each side of the animal's tail, and then tied to those across the loin. The animal is put into a clean kennel and an Elizabethan collar put on in order to prevent the animal interfering with the dressings. If no suppuration occurs the sutures may be removed on about the fifth day, the collar being left on for a day or two longer.

In those cases in which injury to the scrotum or testicles has occurred the operation may be performed in the same manner with the exception of leaving the scrotal wounds unsutured.

Methods similar to those used in other animals are also employed, the testicles being removed by an emasculator, an écraseur, the actual cautery, or by scraping and tearing through the cord. Antiseptic conditions should be observed with any one of them, and the scrotum left unsutured. An Elizabethan collar should also be put on the animal in order to prevent the continual licking of the wounds that would otherwise take place.

Castration of the Cat

The male cat is castrated in order to check its nocturnal wanderings, and to lessen the offensive odour of its urine.

This animal is best held by rolling it up in a stout towel or apron, the tail and hind legs being kept towards one edge. When securely rolled up the opposite end is turned on itself and held closed, thus preventing the escape of the animal from that end. This turning over of the end does away with the necessity of putting any pressure on the head or chest of the animal, which may be attended with fatal results. The hind legs are then grasped above the hocks and pulled free from the open end.

Another way of holding the cat for castration is to grasp the crossed fore and hind legs of the same side in each hand. The thumbs of each hand are put behind the ears, and the head pressed forward between the legs in order to prevent the animal from biting the holder. Although the cat is in a very satisfactory position for the operation the holder has need to be practised in the method if he is to hold the animal securely, and not get bitten or scratched. There is always the risk of one or other of these injuries occurring while the holder is securing or releasing the animal. The method is more suitable for kittens than adults. Another way of safely securing the cat is to put it head downwards into a jack-boot.

The fur is carefully removed from the scrotum with scissors and tincture of iodine applied. A testicle is liberated by incising the scrotum in the usual manner. It is necessary to make sure that the tunics are also incised. This by no means always occurs at the same time that the scrotum is incised, since the tunics are very tough, and whereas they are very intimately applied to the testicle they are very loosely connected to the scrotum, and shoot out readily with the enclosed testicle when the scrotum is incised. It is essential that the testicle should be liberated from its tunics in order that it can be properly and easily removed.

The testicle is removed by cutting through the non-vascular part of the cord and the vas deferens, and twisting and scraping through the vascular portion. The non-vascular part should be cut through separately from the vas deferens. The latter structure is very tortuous and long in this animal, and unless pulled down and severed high up is apt to protrude from the wound in the scrotum.

The scrotum should be picked up after both testicles have been removed in order to ensure that the severed ends of the spermatic cords have receded properly within the scrotum and tunics. E. B. R.

CRYPTORCHID CASTRATION

A "cryptorchid" is an animal in which one or both testicles are out of sight, the organ (or organs) never having descended into the scrotum. It is an abnormality common to all species, but the veterinary surgeon is more frequently called in to operate upon horses than any other class.

If one testicle only is out of sight the animal is called a "monorchid" or single cryptorchid; if both are hidden, the term double cryptorchid is applied. An animal without any testicles at all, either inside or outside the abdomen, is called an "anorchid." The term "rig" or "ridgling" is the country name for any variety of cryptorchid.

In the horse the removal of the testicle is generally a matter of necessity, for a cryptorchid is usually very vicious and treacherous in disposition, and even though the animal may have been of an apparently quiet disposition for some years, experience has taught that it can never be absolutely trusted.

A cryptorchid in which both testicles are really inside the abdomen, although able to copulate, cannot procreate his species; although if one testicle has normally descended into the scrotum, stock will result.

The condition is hereditary and can be propagated through the female line.[1]

Method of Operating on the Horse.—The patient is thoroughly starved for twenty-four or, better still, forty-eight hours, before operating, and water only allowed in limited quantity. The ordinary castrating rope answers well for casting and securing purposes, a "back" rope being adjusted to assist in spreading the legs well apart. Chloroform should always be used, both on humane grounds and for the convenience of the operator. Chloral hydrate can be used, but chloroform is unquestionably the best.

The site of incision and surrounding parts should be shaved and cleansed, and as regards this I have for many years given up the use of soap and water, and either swabbed the parts thoroughly with petrol or painted with iodine. The only instruments required are a scalpel and forceps, two or three pairs of artery forceps, a director, needle and silk, scissors, and an écraseur. A long flexible blunt seton needle is also of service sometimes to enter the abdomen, as is also a small sharp-edged silver-plated tube about 2 inches long with 3 feet of rubber tubing attached, in order to remove the contents of any cystic condition which may be present.

An incision is made through the skin over the scrotal region on the side under which it is suspected that the testicle lies (and here the operator must recollect that because a scar may be present it does not necessarily follow that the testicle has been removed from that side), and a director inserted. The scalpel is thus able to be used without injuring the inguinal plexus of veins, and after that the whole of the opening of the wound is to be done by tearing with the fingers. The fingers are then held wedge-shaped and the hand gradually rotated downwards to the bottom of the inguinal canal. The inner inguinal ring is not actually entered, and if no trace of cord or testicle is detected in the canal the operator carefully scratches a hole through the abdominal muscle with his middle and third fingers, and enters the abdomen. Sometimes the testicle can be felt and withdrawn at this stage without the necessity of introducing the whole hand, although more often than not the hand must be inserted. Once inside, the testicle is sought for, and when found withdrawn and removed by the écraseur. Care must be taken not unconsciously to pass the testicle in the inguinal canal, nor to remove a lymphatic gland or a hard piece of fæces by mistake. Sometimes the epididymis is in the canal and the body of the testicle in the abdomen, and it is not uncommon for each to be excised separately. Sometimes the epididymis is pulled into the abdomen and the complete testicle is extracted by the écraseur at one and the same time through the wound in the abdominal wall.

As guides by which to make a methodical search one attempts to find either the spermatic artery or the vas deferens, from either of which the testicle may be traced up. When found, the testicle is recognized by its shape, by the fact that the epididymis is attached to it, by its flabbiness and smooth surface, and because it is a body by itself. Pressure upon it, if the patient is not deeply anæsthetized, will cause struggling. After removal by the écraseur and careful cleansing of the wound, the edges of the latter are sutured, the sutures being about half an inch apart. The animal is then allowed to get up, and as regards after-treatment the diet should be sparing for at least a week. The middle sutures are removed three or four days later and the parts treated antiseptically like any ordinary wound.

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[1] *Castration and Ovariotomy* (Hobday), p. 40. Published by W. & A. K. Johnston, Ltd., Edinburgh.

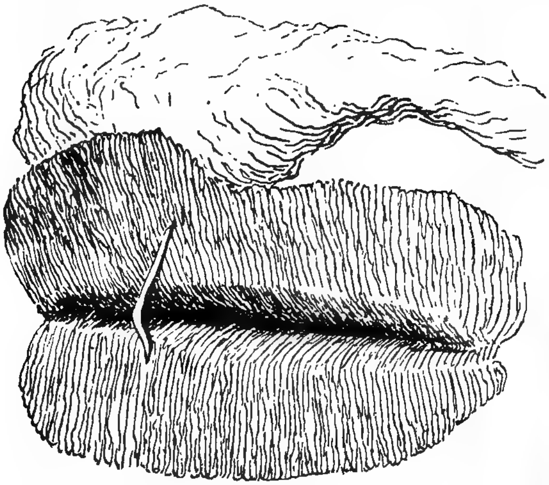
FIG. 312.—An abdominal testicle partly laid open to show a specimen of the *Strongylus armatus* in situ.

If the operator has rigidly followed the rules of careful antiseptic procedure, and a clean place is selected for the patient afterwards, the proportion of losses is infinitesimal, and the patient is convalescent within a week or ten days.

Abnormalities.—These are many and curious. In the first place, the size and shape of the testicle is often quite out of the common. The size may be small, or it may be enormous and due to a cystic condition or to the presence of tumour tissue. If cystic, the contents may be merely fluid or it may be accompanied by tumours of various sizes and varieties. It may contain teeth (incisor or molar), hair, or nests of the *Strongylus armatus* worm. Whatever is present must be removed, and sometimes the size of the tumour necessitates a large wound through which it has to be withdrawn.

Sequelæ.—If the operation is performed under anæsthesia and in a reasonable time so that the patient is not exhausted, the sequel is usually an absolute success and the horse is convalescent within a week or ten days, or at worst within three weeks.

The untoward sequelæ which may happen are those of hernia, prolapse of omentum or bowel, colic, peritonitis, septicæmia, abscess, or paraphimosis.

As a rule, if hernia does not appear within a few hours, there is sufficient swelling of the tissues surrounding the wound to keep the bowel in the abdomen, although I have known descent of the bowel to occur as long as a week afterwards. The chief precautions to take to prevent this sequel are to suture the wound closely and to keep the patient quietly in a standing posture with the hind legs raised for at least twenty-four hours. If hernia does occur, whether it is merely omentum or bowel, it is necessary that it shall be reduced as soon as possible. For this purpose the horse must again be cast, and the contents of the sac returned to the abdomen, the wound being closely and securely sutured.

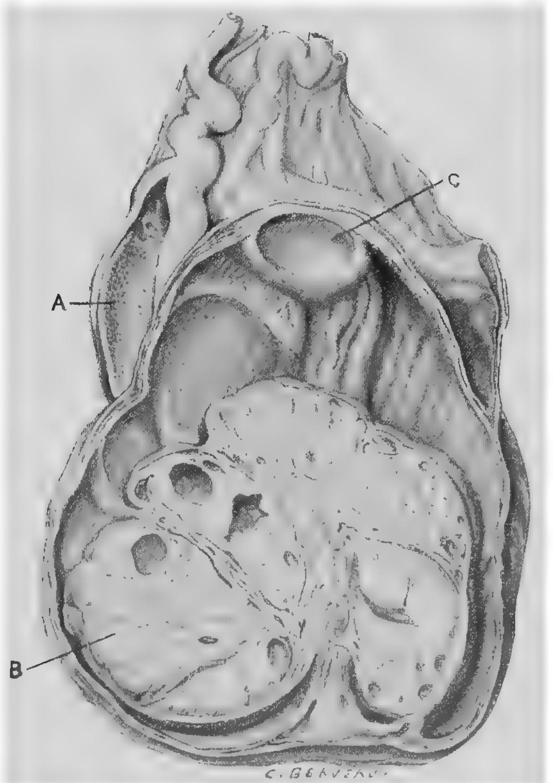

FIG. 313.—Embryoma of the testis.
A, true testicular tissue; B, tumour tissue; C, cyst.

The operator need not despair of a successful result, for many horses have done well after this untoward sequel has been attended to. It is usually a wise precaution to plug the inguinal canal with antiseptic wadding or gauze, this being removed and replaced by a fresh plug two or three days afterwards at the discretion of the operator.

Colic is usually an indication that the above untoward sequel has occurred, and as such it should never be neglected. It usually means that a loop of bowel is down in the scrotal sac, and is being pinched or perhaps strangulated. Exploration is always a wise procedure if colic lasts for more than four or five hours, and if a loop of bowel is discovered in the inguinal canal this must be returned to the abdomen as speedily as possible.

Peritonitis and septicæmia indicate that infection has taken place either at the time of operating or subsequently, and the prognosis must always be a very serious one. Treatment consists in the frequent and thorough cleansing of the wound, as far as may be possible, and the hypodermic injection of antipyogenic sera.

Abscess is treated in the usual way by lancing and irrigating with antiseptics.

Paraphimosis is a very troublesome condition to treat, and it may even terminate in paralysis of the penis. Scarification should be resorted to in the early stage of the swelling, together with hot fomentations and astringent lotions, whilst the organ is placed in a sling in order to give it support. Nux vomica or other nerve tonic is given internally.

Cryptorchidism in other Animals.—Misplaced testicles are met with in other species besides the horse, although, if it is a food animal, the beast is usually fattened and sold, being hardly worth the trouble and expense of the operation.

In the bull it is not uncommon to find one or both testicles subcutaneously placed in the groin, or well forward in front of the inguinal canal. Occasionally they are met with in the abdomen. When they can be felt subcutaneously it is a matter of ease to remove them, and if in the abdomen, the incision by which they are reached is made in the right flank. It can be done either under cocaine, with the animal in the standing posture, or with the animal cast. Chloroform can be used if preferred.

Under antiseptic precautions, the incision is made in a downward and slightly diagonal direction through the skin and muscles, the testicle is sought for and removed by the aid of an écraseur, and the parts sutured and painted with iodine daily until healed.

In the **Ram** cases of cryptorchidism are occasionally brought into prominence by legal disputes, but the question of expense militates against the operation ever becoming a common one; the owner usually preferring to let the animal go to the butcher. Here, as in the bull, the incision is made in the right flank, usually without an anæsthetic, and with the operator sitting astride his patient. The testicle, when found, is removed either by the écraseur or by torsion. The percentage of fatalities is very small.

In the **Pig** the flank is chosen, just as when operating upon the female, and the cord is usually scraped through, unless the animal is of large size, in which case it is removed either by the écraseur or the clam and iron. The latter is the favourite method of the country gelder.

In the **Dog** cryptorchidism is not at all an infrequent source of dispute in the law courts, and on more than one occasion a vendor has been accused of castrating a puppy before sale, when in reality the animal has been a double abdominal cryptorchid.

On four separate occasions it has been the author's lot to settle such insinuations on the part of the purchaser, the result of the operation in each case being to return the castrated dogs and the perfect testicles removed from the abdomen to the disputing parties.

A cryptorchid dog is a continual nuisance to its owner, and is often treacherous too, so that castration becomes necessary. Under chloroform or morphia, and the usual antiseptic precautions, an incision about an inch long is made in the median line of the abdomen, and the forefinger or middle finger inserted in a backward direction towards the pelvis. As a rule, the testicles are easily found floating about in the pelvic region. They are withdrawn, and removed either by scraping or after ligation. The abdominal wall is then sutured, and the wound treated in the usual way.

In the **Cat** the same operation applies as in the dog, and quite a large proportion of cats are found upon examination to be cryptorchids. The removal of the testicle is a necessity in a pet cat on account of the objectionable smell of the urine in an uncastrated animal. The results are excellent in every way.

Experience has taught that before a final opinion is given that the missing testicle is in the abdomen, careful search should always be made subcutaneously in the region of the groin or abdomen, for it is not difficult in cats, especially Persians, to overlook a small testicle in this situation. F. T. G. H.

SPAYING
(OÖPHORECTOMY OR OVARIOTOMY)

By the term "spaying" is meant the unsexing of the female animal by the removal of the ovaries.

This may be done when the ovaries are healthy, in order to prevent the troublesome characteristics exhibited by the female when in œstrum, in which case the operation is technically known as "Oöphorectomy," or it may be done when the ovaries are diseased, being then termed "Ovariotomy."

The term "Hysterectomy" indicates the removal of the uterus alone, and "Ovaro-hysterectomy" the excision of the ovaries and uterus; whilst "Hysterotomy" or "Cæsarean section" indicates the removal of the fœtus or fœtuses from the uterus by incision into this organ, the wound being sewn up, and the uterus being preserved afterwards.

"Spaying" is practised upon all the domesticated animals. The mare is operated upon when troublesome or vicious, the cow for milk and meat utility, the pig for fattening purposes, and the bitch and cat when they become a nuisance to the owner from continually having young ones. Even the female ostrich and the common fowl do not escape, but are operated on frequently in this way.

The ovaries alone may be removed, but more often than not, in the smaller animals, the whole uterus is removed as well as the ovaries, and the results show that this is an excellent practice to adopt. The ovaries of the mare and the milking cow are removed *per vaginam*, but in the smaller animals the flank or the linea alba is the best site to select.

The operation itself is one which calls for the strictest antiseptic precautions in regard to everything concerned. The instruments must be carefully sterilized, the hands of the operator thoroughly cleansed, and the parts to be operated upon made aseptic before the operation commences.

The pig is the only animal in which a little laxity in this respect does not seem to cause any large proportion of bad results, but even in this animal strict attention to surgical cleanliness pays in the long run, and is always a precaution to be adopted by the professional man.

Ovariotomy of the Mare.—This operation is a most valuable one for mares in continual œstrum, especially if they are vicious kickers or squealers from this cause. It is one which gives success in a large proportion of cases, especially in those taken at the commencement of the vicious habits. The failures are usually to be found in aged mares, or those in whom kicking has become a confirmed habit. Removal of the ovaries when healthy (Oōphorectomy) is sometimes practised in racing mares in order that when put in training they can be relied upon to keep in better condition during the summer, and not to "hug" another horse during a race. It makes them more even-tempered. In some cases of disease of the ovary or ovaries only one organ may be affected, and the removal of this is done as a curative measure. This has been done in mares where the pain and irritation caused inability to breed a foal, the result of the removal of the diseased ovary being that the other resumed its normal function, and a foal was afterwards born.[1]

As a rule, in troublesome mares, the ovaries are diseased—sometimes cystic and enlarged, sometimes smaller than normal and cirrhotic.

Operation.—This can be done either with the patient standing or cast. In the former chloral is used as the anæsthetic, and the animal, if possible, placed in stocks. When cast, chloroform anæsthesia is used. No special method of securing is necessary other than that used for ordinary chloroform cases.

The usual precautions are taken for the sterilization of the instruments and the hands of the operator. The vagina is thoroughly irrigated with antiseptic solution, and the operator cleanses his hands.

The mare has been previously dieted for three or four days and kept without food at all for the previous twenty-four hours.

If an enema is used or catheterization is practised, this should be done an hour beforehand, and the tail and vulva thoroughly washed with soap and disinfectant water. Very often, however, owing to the temper of the mare, this is impossible until she has been cast and secured.

The side upon which she is thrown depends upon the convenience of the operator. After emptying the vagina of any disinfectant solution which may be present, the operator introduces Colin's knife, concealed in his hand, and punctures the wall of the vagina just above the mouth of the uterus. Some operators prefer to puncture the vagina below the os uteri, but the intestine is not so likely to come through the incision made above the os uteri as when made below.

Having made the incision the operator withdraws the knife, inserts the middle finger into the wound, and proceeds to enlarge it sufficiently to admit the whole hand. It is an easy matter then to trace along the body and horns of the uterus until one comes to each ovary in turn. The latter are removed, one at a time, with the special écraseur, care being taken that no intestine or other of the internal organs shall be included.

After both have been removed the vagina is swabbed out with antiseptic gauze or wool, and the patient allowed to get up.

As a rule no further treatment whatever is needed for the wound, but the patient is kept quiet for three or four days and fed sparingly and with food of a laxative nature. The latter is necessary as, if constipation occurs, considerable soreness and stiffness may be shown.

As a rule the animal is back at work again in about three weeks.

In young mares, in which the vagina is too small to allow of the passage of the hand, the operation is performed through the flank. This is largely done on certain of the large ranches in America—no anæsthetic being used—the mare simply being cast and secured with ropes until the operation is finished. The left flank is shaved and disinfected, and an incision made between the last rib and the angle of the haunch just sufficiently large to admit the hand. The ovaries are found and removed with an écraseur. The wound is sutured, the animal is unfastened and allowed to return to the prairie (if on a ranch), or placed in a comfortable loose-box (if in England).

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[1] *Castration and Ovariotomy* (Hobday), p. 113. Published by W. & A. K. Johnston, Ltd., Edinburgh.

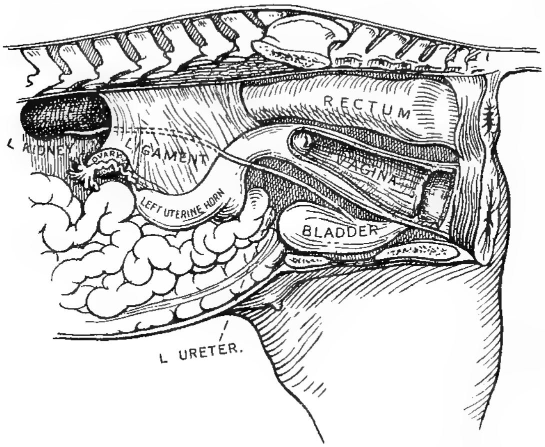

Fig. 314.—Position of genital organs.

After-treatment is the usual antiseptic one for a flesh wound, care being taken that the dietary is laxative and sparing for about a week. As soon as the flank wound has healed satisfactorily, the animal may return to work.

Untoward Sequelæ.—The main untoward sequelæ are those of protrusion of the intestine, eversion of the rectum, hæmorrhage, colic, peritonitis, and the formation of an abscess in the vagina. None of these is common when the operation is done under antiseptic surgical precautions, and if any of them should occur they must be treated in the usual way.

Remarks.—The results of this operation, except in cases where the animals are old, or have been vicious for some considerable time, are most excellent; the operation having much the same effect on the mare as castration has on the stallion.

Ovariotomy of Cattle.—This operation is performed upon cattle either with a view to increasing the milk supply or of inducing them to fatten quicker. In dairy herds, especially in Switzerland, the operation is very extensively practised on cows about eight or nine years old, when they are nearing the age at which their dairy utility is diminishing, and it is a remarkable fact that the milk supply is thereby increased in quantity and enriched in quality, whilst the period of lactation is extended to an average of about eighteen months, and some have been known to give a paying quantity of milk even for three or four years. Old cows, too, which have been " spayed " fatten quicker, and the flesh becomes more tender, resembling " steer " beef, rather than the flesh of an old cow. Calves and heifers are still " spayed " in some counties of England, although it is on the big ranches of America that the operation has been brought to a fine art. Where thousands of cattle are reared for beef-producing purposes it is an operation which pays well, as the animals herd more kindly together and put on flesh more quickly. Heifers and calves are spayed through the left flank, the milking cattle being spayed *per vaginam*, and it is not usual for a general anæsthetic to be used in either instance, the animal being operated upon in the standing posture, and the parts to be incised anæsthetized with cocaine.

The Flank Incision in Ovariotomy of Cattle.—In heifers and adult cattle destined for the flank method the animal is tied up and " bulldogs " placed on the nose, an assistant holding her by these and the horns. Another assistant takes hold of the tail and presses the cow against the side of the byre or wall, whilst the operator shaves the hair, injects the cocaine, paints with iodine, and makes an incision in the upper part of the left flank.

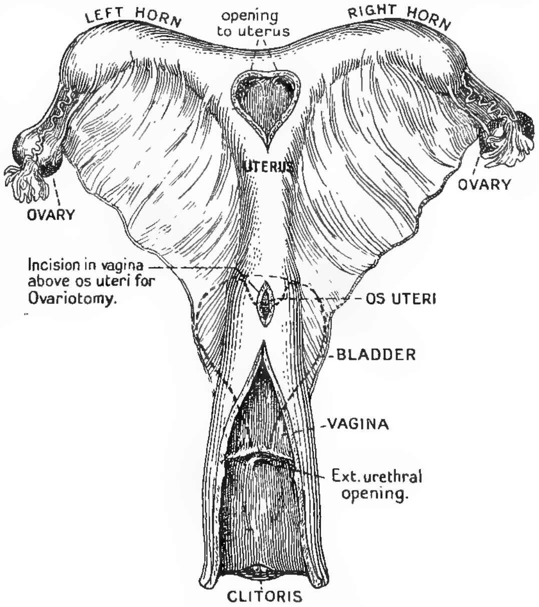

Fig. 315.—Vagina, uterus, and ovaries.

With the hand he seeks the ovaries and, when found, removes them with an écraseur.

The wound is then sutured closely with boiled silk, dressed each day with iodine, the stitches being removed a week later.

On ranches, and where large numbers are done, no further notice is taken of the wound.

Calves are thrown on the side and secured by a rope in the usual way.

For dairy cows the vaginal method is preferable, and there is always plenty of room in which to work after a cow has had several calves. The mode of operation is as follows :

The tail and genitals are washed and syringed with antiseptic solution, and the interior of the vagina swabbed out with sterilized wool. Solution of cocaine on cotton-wool is applied to the vagina at the site of incision, immediately above the os uteri, and this is then punctured with a Colin's knife ; care being taken not to injure the aorta or any of the internal organs of the abdomen.

The opening is then enlarged sufficiently to admit the middle and forefingers, which are passed through in order to seek for the ovaries. As a rule these can be withdrawn without inserting the whole hand. With the left hand the operator passes the écraseur into the vagina, using his right arm as a guide. The ovaries are guided into the chain loop, being pinched off slowly one by one. As a rule, beyond giving less milk for three or four days, the cow takes no notice of the operation, but there is the risk of peritonitis and internal hæmorrhage to be thought of, and the author has seen death from each as a sequel.

Results.—The average monthly supply of milk becomes greater, and the duration of lactation is prolonged for an average of twenty to twenty-four months, besides which the milk supply is more constant, as the troublesome periods of œstrum are done away with ; or, if they occur at all, they are very short in duration. The milk has been proved by analysis to be richer in butter fat, and when the cow " dries off " she is sufficiently fat to be almost ready for the butcher.

The actual yield of meat is said to be increased about 6 per cent.

Ovariotomy of the Bitch and Cat.—The continual nuisance of a female cat or a bitch about a house is the reason for the unsexing of these animals. It is not in every case a success as regards the cessation of œstrum, but this is generally the sequel, especially if the animal is operated upon before œstrum has taken place. At any rate pregnancy is an impossibility.

Morphia is a sufficient anæsthetic for the bitch, although chloroform can be used if desired, and for the cat either chloroform or ether.

The ovaries can be reached either through the flank or the linea alba, and the preparation of the site of incision is made in the usual antiseptic way. For the cat, owing to the crouching or sitting attitude assumed afterwards when resting in a cage, undoubtedly the flank situation is the best ; but whichever is selected, provided the strictest precautions have been adopted as regards antiseptics, the wound will usually heal *per primam*.

As regards the question of the removal of the ovaries and uterus together or the removal of the ovaries alone, the latter is undoubtedly preferable, except in the case of an animal whose uterus is enlarged. The incision having been made, the operator inserts the middle finger and seeks for one of the uterine horns, which feels like a piece of thick string. This is withdrawn, or merely scraped at discretion before removal, and the other side traced up in the same way—both being removed through the one incision.

The wound is then sutured with sterile gut for the interior, and silkworm-gut or silk for the skin. The animal is kept quiet for a week or ten days. As a rule the patient takes no notice of the operation. The sutures are removed in five or six days, the diet being restricted during this period. The dangers to be feared are those of peritonitis, hæmorrhage, and escape of the omentum or bowel through the sutures giving way.

Ovariotomy of the Monkey.—For this, chloroform or A.C.E. mixture is used as the anæsthetic, the ovaries being reached through the median line.

The principles to be adopted are the same as for the bitch and cat. It is not usual to remove the uterus, the ovaries only being taken away.

Ovariotomy of the Pig.—Thousands of female pigs are operated upon every year in order to increase their fat-forming properties, and as the fee for each operation only amounts to a few pence, it is usually done by the country gelder, who becomes so expert that he will do it from start to finish in an average of about thirty seconds.

It is usually done when the " gilt " is from six weeks to three months old, the operator holding the animal by the left hind leg and placing his foot on the neck, slightly raising the hind quarters off the ground. Then stooping over the patient, he deftly makes an incision in the left flank, inserts his middle or forefinger into the abdomen and extracts the uterine horns, which are then excised. A cross suture (usually of string or thread) draws the wound together and the pig is allowed to get on her legs and escape. No after-treatment is employed, the sutures being rubbed out or falling out in the course of about ten days.

Adult sows are operated upon through the left flank, generally without an anæsthetic, the squealing animal being secured between two posts by the aid of one noose on the upper jaw and another on the hind legs.

Ovariotomy of the Sheep and She-goat.—Sheep and goats are not "spayed" to any appreciable extent in England, but in some countries it is done; in the former case to increase the fattening properties, and in the case of the goat to increase the milk-producing power. The operation is performed in the left flank in much the same position and manner as with the adult sow. F. T. G. H.

LAPAROTOMY, OR ABDOMINAL SECTION

It is said that Henon (1800), professor at Lyons Veterinary School, frequently performed this operation, but particulars of his cases have not been published. In England laparotomy was performed on a mare by King, of Stanmore, in 1829. The mare had been affected with abdominal pain for thirteen days, during which time she had been bled, purged, and clystered without benefit. King secured the animal in the erect position, incised the left flank, introduced his hand, and soon found a portion—about twelve inches—of the small intestine stuffed full and quite hard, and the gut in front of the obstruction full of fluid. He grasped the obstructed bowel, pressed it gently, and mixed its contents with the fluid. Having softened the mass in the bowel, he closed and dressed the wound in the flank. The mare died six hours after operation. Three years later, Gaullet operated on a moribund ass in which he had diagnosed obstruction of the pelvic flexure of the colon. He opened the flank, incised the gut—which was almost black—extracted a concretion, and closed the wounds with coarse sutures. The patient died in twenty-four hours. The next, and to this day the only successful laparotomy performed on a horse affected with intestinal obstruction, is that recorded by Félizet, of Elbœuf. In June 1849, Félizet was called by a miller to see a horse, about nine years old, that had been affected with colic for about sixteen hours. Two or three times within four months the horse had shown symptoms of constipation. Clysters had been given, but no other remedy. Rectal examination discovered a concretion, as large as a child's head, at the beginning of the floating colon. Félizet was positive of the existence of the calculus. As death seemed the only possible result, the miller was informed that his horse could not live much longer. But a conversation between Félizet and a farmer probably saved the animal's life. Five days before, the farmer's colt in jumping a hedge had opened the abdomen and torn the point of the cæcum. Fèlizet treated the wounds, but gave no hope of recovery. The farmer now told him that the colt had made wonderful progress; and on learning this, Félizet was struck with an idea as bold as it proved to be fortunate. At once he decided to return to his patient, the miller's horse, open the flank, and extract the calculus. Unaided by anæsthetics and antiseptics, he performed laparo-enterotomy. The horse was thrown on the left side; the upper hind leg, unhobbled, was drawn backwards and lashed to a stout pole. The skin of the right flank was incised longitudinally, the muscles were divided with forefinger and thumb, and the peritoneum was opened with the point of a bistoury. The left hand with fingers extended within the abdomen prevented protrusion of bowels, while the right hand in the rectum pushed the obstruction towards the flank. Acting together, the hands passed the tumour through the wound. The right hand was now withdrawn, and cleansed by an assistant. The distended bowel was gently wiped, and incised two fingers' breadth from the mesentery. To facilitate extraction the concretion was reduced by separating its fæcal crust. A furrier's suture was used for the wound in the gut, the muscles were stitched in layers, and a strong quilled suture closed the wound in the skin. Sweating profusely, the horse was allowed to rise. He was poulticed on the loins and bled six times at intervals of three hours, twenty-one pints altogether being withdrawn. During the next four days he drank from twelve to eighteen pints of water every twenty-four hours, but he refused to eat either hay or grass. He groaned when moved, was dull and very stiff. Two days later his appetite returned, and by the ninth day he fed well, looked bright, and moved freely. The wound healed rapidly. In about a fortnight he was put to work on the land, and in September of the same year he was bought for 1100 francs by a Paris merchant, who was very much pleased with his purchase.

It is to be regretted that the report does not contain particulars of the length of the incision, and of the material used in stitching the bowel. A furrier's suture implies the passage of the silk or other thread through the whole thickness of the gut, and as a consequence considerable risk of leakage.

To relieve obstructed bowel in the horse, laparo-enterotomy was performed by F. Smith in 1889, by Dollar, Rickards, and Rogers, and by Garry in 1894. These cases did not recover, and the reports show that death was mainly attributable to the operation having been too long delayed. Woodruff, in 1911, performed colotomy in a hackney mare and, five weeks later, entero-anastomosis, but the mare died two days after the second operation.

Before Charlier made known his method of spaying *per vaginam*, mares were always castrated through the flank, and occasionally, even now, as a successful case recently reported by Martin goes to prove, the older operation is preferred.

Frequently cryptorchid horses have been castrated through the flank, and it may be said that the usual operation for abdominal cryptorchidism is effected by laparotomy slightly modified.

Laparotomy has been performed oftener on cattle than on horses. Few fatalities have been recorded. In oxen invaginations have been reduced, herniæ liberated, and the bowel has been resected. Probably the earliest operation is a laparo-enterectomy or resection performed by Thomas Brayn, a cattle-doctor of Yeaton, Salop, in 1730. Brayn was called to an ox suffering with obstinate constipation. He opened the flank, searched for the obstruction, and found "the gut was about the stoppage putrefied for about three-quarters of a yard." This part he excised, then drew and stitched the ends of the sound gut together upon "a hollow keck" three or four inches long, and closed the hole in the flank. The ox passed the keck, recovered, and served its owner usefully for several years.

Intussusception was successfully reduced in 1839 by Anker of Berne, who had operated frequently in cases of pelvic hernia.

Meyer opened the right flank of a cow, brought the invaginated bowel outside, and failing to effect reduction, excised about six feet of gut which was becoming gangrenous. To facilitate anastomosis, Meyer inserted into the bowel a piece of paper rolled up and greased. The edge of the posterior gut was inverted, and the anterior end passed into it for about an inch and a half. The serous surfaces were united by a continuous suture of well-waxed thread passed through the serous and muscular coats.

Taccoen operated on two cows. From one he removed ten inches of gut. The external wound healed in thirty-five days. In the other cow an artificial anus formed, but this did not impair her health.

Riedinger treated ten cases of invagination in oxen. Seven had to be slaughtered; and in three the invagination was reduced, but only two recovered completely.

Degive diagnosed invagination in a cow. He incised the flank, brought the intestine outside, and, after considerable difficulty, effected reduction. The cow recovered in three weeks. Riis reports a similar case. He found the volvulus with ease and drew it to the opening in the flank. The gut was swollen and congested. It was bathed with weak sublimate solution, gently pressed for fifteen minutes, and reduced. The cutaneous wound was closed with fifteen button stitches. The animal fed in the evening and completely recovered.

Diagnosis.—Abdominal diseases amenable to surgical treatment may be diagnosed in dogs by manipulation, in cattle by rectal exploration or by rumenotomy, but in horses diagnosis is extremely difficult because of the size, disposition, and relations of the viscera and the common symptoms they provoke when diseased. The history of the patient; the character of the pain, whether intense and continuous or subacute and intermittent; distension, local or general; constipation, persistent or interrupted; the action of eserine; the posture of the patient; backing; straining; the quantity of urine passed; the rejection of clysters; expulsion of flatus; and the symptoms sometimes afforded by palpation, percussion, and auscultation, merely suggest a possible cause—all are fallacious and unreliable in the diagnosis of abdominal diseases. If examination per rectum gives more assistance, it does not always yield satisfaction. The height of the operator and the length of his arm should be considered as well as the state of the horse's bowels. In a healthy horse, fifteen hands high and of medium coupling, the hand may reach the cœliac axis and the last rib. In a long-loined, sixteen-hands carriage horse, lying on his right side, the border of the spleen, the last rib, and the left kidney can be felt, but in the standing horse the spleen cannot be reached. Experiment warrants the assertion that an imaginary vertical plane falling from the first lumbar vertebra to midway between the xiphoid and umbilicus represents the forward limit of rectal exploration. Employing the left hand for the right half and the right for the left half of the abdomen, all the viscera behind this boundary may be examined more or less satisfactorily — in the healthy horse. In abdominal disease, especially in obstruction, the intestines are often crowded towards the pelvis, and frequently the hand cannot pass onwards in consequence of straining and pressure from distended bowels. But when the hand has reached the flank it may, and sometimes does, discover displacements, volvulus, or invagination; recognize and remove concretions; ascertain the condition of the contents of the colon, cæcum, floating colon, and small intestine; and in herniæ distinguish and liberate omentum and bowel. Cases that give no sign to exploration are uncommon, and without this precious aid diagnosis, whether positive or negative, is doubtful. In this, as in other diagnostic efforts, the spirit of the practitioner dominates procedure. With faith in possibilities, rectal exploration may be tried again and again, and information may be gained at every investigation.

In the majority of cases, volvulus, invagination, internal herniæ, and obstruction by concretions, bands, or pedunculated tumours cannot be definitely diagnosed without resorting to exploratory laparotomy. With anæsthetics to suspend the movements of the patient and antiseptics to prevent infection of the wound, exploratory incision is justifiable in any lingering case of bowel obstruction. Volvulus or twisted small intestine in the horse is never likely to be successfully reduced because of the intricacy of the condition, but obstruction due to concretions, intussusception, or torsion of the pelvic flexure of the colon is within the range of the operating veterinary surgeon.

Laparo-enterotomy.—Materials, etc., required: Aseptic cotton-wool or small sponges for use inside the abdomen and about the bowel. Pieces of aseptic gauze, tarlatan, or fine muslin for packing round the bowel brought outside the abdomen. Enamelled trays for instruments, ligatures, and needles. Zinc pails for saline solution, carbolic lotions, etc. Some 20 per cent carbolic or other antiseptic soap for washing hands and horse's flank and for shaving the skin. One aseptic scalpel and a razor. Two elbowed scissors, sharp- and blunt-pointed, to divide muscles, open peritoneum and bowel. Two sponge-holding forceps. Two Thornton's T-shaped forceps to stop bleeding from skin or muscle. Two Wells's catch forceps, and one or two spring and dressing forceps. A few straight and curved suture needles. Twenty milliners' needles, straws No. 5, for stitching the gut. Prepared Chinese twist for all sutures—No. 1 for the gut, No. 3 for muscles, and No. 6 for the skin. A fine trocar and cannula, to puncture, if necessary, distended bowel. A convenient supply of hot water, and a piece of fine muslin several layers thick for use as a filter for water to be used for lotions or for irrigation. Chloroform and an inhaler with sponge; and some pure carbolic acid in a graduated bottle. A quantity of pure sodium chloride for making normal saline solution (one dram to the pint of boiled water). For dressing the wound the following should be ready: Iodoform and tannin, 1 to 3; antiseptic cotton-wool and tow; carbolized gauze; a piece of calico, six yards by nine inches; roller bandages; and a few safety-pins.

Preparation for Operation.—Before casting the horse, the flank from spine to groin and from haunch to sixteenth rib is clipped and washed. When the horse is under chloroform, the flank, within two or three inches of the boundary marked by clipping, is shaved and disinfected. While these preliminaries are proceeding, the pails and trays are arranged and filled. All the solutions must be warm, and the water used in their preparation passed through muslin.

Abdominal Incision.—The linea alba offers the least vascular and shortest route to the interior of the abdomen. Through an incision of the white line any organ within the cavity can be felt, the small and large intestines in part can be seen, and to some extent portions of these viscera can be withdrawn; but the colic mesentery is too short to permit the first part of the floating colon to pass through the wound. Besides, if the incision is made at this point the wound does not heal rapidly, and adhesion between its peritoneal surface and omentum or bowel is a probable complication. In the horse, incision of the abdomen an inch or two to the right or left of the linea alba is equally objectionable. When the floating colon has to be opened, the bowel can be reached most conveniently through the flank. In opening the flank three wounds are made before touching the peritoneum. The first divides the skin, fascia, and *external oblique muscle*; the second the *internal oblique*; and the third the *transversalis*. The first starts at a point four inches below the lumbar transverse processes, midway between the angle of the haunch and the last rib, and passes downwards and forwards for seven or eight inches. The forward direction of this incision is opposed to all teaching, but its advantage is conceivable. The upper hind limb is unhobbled and drawn backwards. The wound gapes and exposes the internal oblique muscle, which is then cut with scissors in the direction of its fibres. A similar opening is made in the transversalis. The third wound exposes a layer of fat which is lined by peritoneum; this is pierced with the finger, and the opening is enlarged with scissors in the

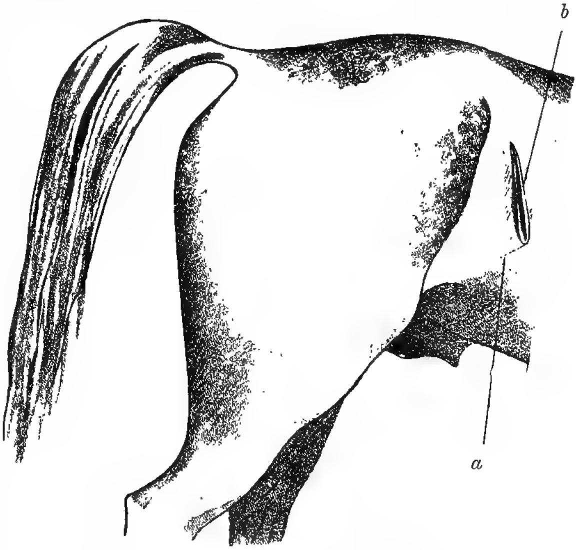

Fig. 316.—Operation wound, right flank.

a, secondary wound for drainage; *b*, position of first incision through skin and across fibres of external oblique muscles.

direction of the transversalis wound. Bleeding must be stopped before the peritoneum is punctured.

Incision and Suture of the Bowel.—In Félizet's case the gut was opened two fingers' breadth from the mesentery. But the bowel should be opened at the middle of the longitudinal band—where the wall appears strongest and most capable of supporting sutures. With sharp-pointed elbowed scissors the gut can be punctured and the wound extended without the slightest difficulty. The wound is closed with sutures of prepared Chinese twist No. 1.

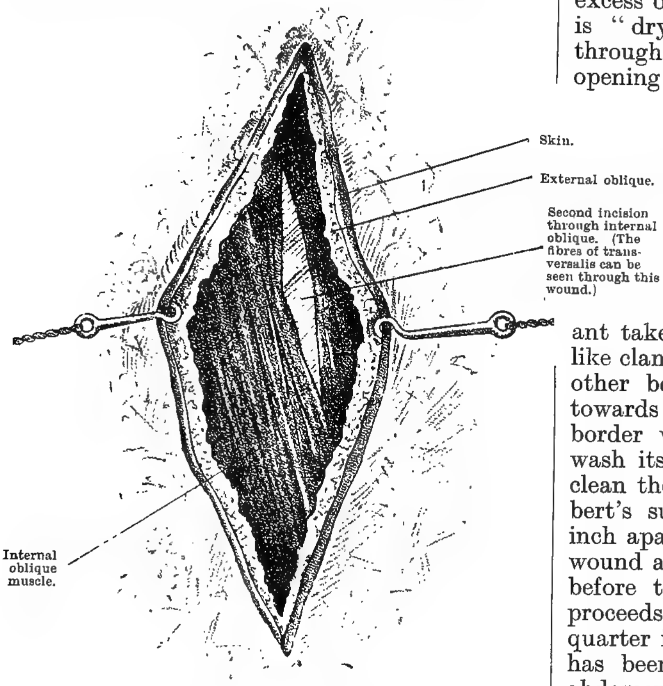
Skin.
External oblique.
Second incision through internal oblique. (The fibres of transversalis can be seen through this wound.)
Internal oblique muscle.

FIG. 317.—Incision of the right flank.

Sutures applied by Lembert's method pass through both the serous and muscular coats; the mucous membrane must not be punctured. The needle enters one-quarter inch from wound, passes through muscle for one-eighth inch, then pierces serous one-eighth inch from the edge of the wound. It is then carried across the wound, reinserted one-eighth inch from edge, passed through muscle for one-eighth inch, and brought out one-quarter inch from the wound. A glance at the diagram will enable any one to understand the course of the needle. The sutures are placed one-eighth inch apart and tied separately. The ends are shortened to within one-quarter inch from the knots.

Operation.—Cast the horse on left side, and give chloroform. Wash, shave, and disinfect the flank. Spread sponge cloths, wrung out of carbolic lotion (5 per cent), in front and behind area of incision. Incise skin and external oblique; unhobble upper hind limb, draw it backwards, and fix to a post or wall. Douche wound with warm carbolic lotion (2½ per cent) and stop bleeding from skin and muscle. With elbowed scissors slit internal oblique muscle in the direction of its fibres, trim the edges, and stop bleeding. Snip transversalis with scissors, and extend opening with finger, taking care not to puncture fatty layer or peritoneum. Examine wound and check bleeding. Sponge with warm carbolic lotion (2½ per cent) and remove excess of fluid. When satisfied that the wound is "dry," rinse the hands, push the finger through fat and peritoneum, and enlarge opening with blunt-pointed elbowed scissors. Pass a large sponge, wrung out of (2½ per cent) warm carbolic solution into abdomen, and get tarlatan ready. Pass the hand into abdomen, bring out the bowel, and hold it gently until the assistant has placed pieces of tarlatan, moistened with warm carbolic lotion (2½ per cent), round the wound. This done, let the assistant take the bowel between his fingers applied like clamps, the hands resting one in front, the other behind the wound. Incline the bowel towards the horse's thigh, and slit the free border with scissors. Remove contents, and wash its mucous lining. With a fresh sponge clean the edges of the wound, and apply Lembert's sutures. Place the stitches one-eighth inch apart, and insert two or three beyond the wound at each extremity. Pass all the sutures before tying any. Wipe the edges as tying proceeds, and shorten the suture ends to one-quarter inch from the knot. When the wound has been closed, pull the bowel well out of abdomen, and let assistant renew his hold. Carefully sponge off clots, hairs, and suture ends, and douche with normal saline solution in boiled water that has been allowed to cool to about 106° F. Remove packing from round the wound, let the bowel slip into abdomen, and withdraw the sponge. Look inside, and, if necessary, pass in a fresh sponge to take up clots or fluid. Adjust the edges of transversalis wound, and excise protruding fat. Pass two or three sutures (twist No. 3) through internal oblique muscle, and sponge the surface with carbolic lotion. Rehobble upper hind limb, and bring edges of external oblique together with a few fine sutures. Close the external wound with strong (No. 6) twist sutures passed through skin and muscle, tied in front or behind the line of union. Then slit skin and fascia downwards and backwards to two inches from lower end of first incision. This will drain the operation wound. Sponge the surface with carbolic lotion, and let the horse rise. Dust the flank with iodoform and tannin, insert aseptic tow in drainage wound, and cover the whole with carbolized cotton, protected with four layers of gauze. Support the dressing by winding calico round the body, and roller bandages secured with safety-pins. Muzzle the horse for five or six hours, but leave his head loose. Encourage, but do not force, exercise. For a few days restrict his diet, which ought to be somewhat laxative. Dressings should not be renewed until oozing occurs; then redress, but do not plug the drainage wound. The dressings might be substituted with advantage by a pitch plaster or a mild blister.

Enterectomy (excision of part of the intestine).—This operation is indicated in some cases of invagination, "twist" or strangulation that cannot be reduced. Successful operations in cattle have been recorded by Brayn, Meyer, and Taccoen; and in dogs resection of the bowel experimentally has frequently been performed.

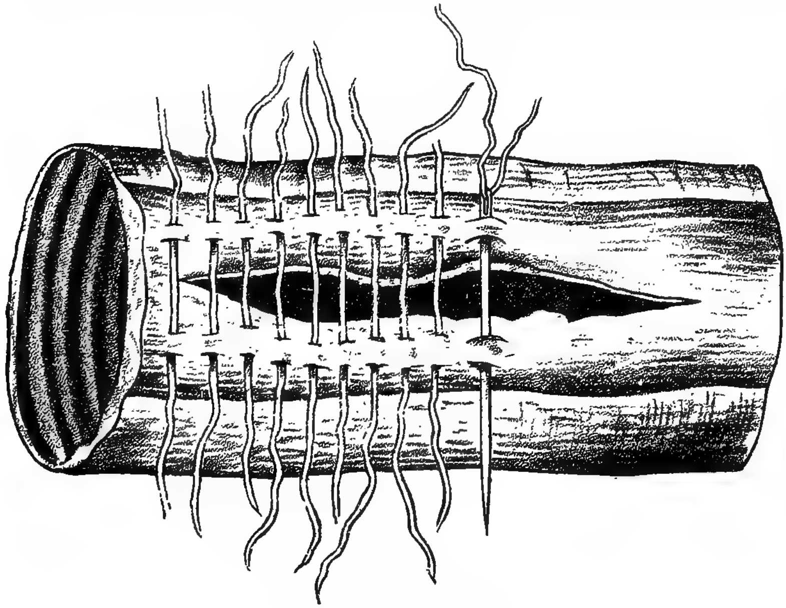

Fig. 318.—Lembert's sutures.

In operating on the small intestine of the horse, the abdomen may be opened at the flank or near the linea alba. The bowel is brought out and clamped in front and behind the obstruction, care being taken to apply the clamps over sound bowel two or three inches from the strangulated part. Within two inches of the clamps, along a line near to the attachment of the diseased segment, the mesenteric vessels are tied; the bowel is then detached from its mesentery, divided at two places, and removed. The continuity of the gut is restored by continuous or interrupted sutures passed through serous and muscular coats of the inturned ends. The mesentery from which the bowel has been separated is carefully folded to the right or left, and secured by sutures of fine twist placed at the borders of the fold, or a piece of mesentery can be excised and the edges united by continuous suture; but whether folded or excised no gap should be left between mesentery and bowel. If clamps are not employed, the ends of the gut should be drawn over a piece of trachea or decalcified femur, and the edges inverted before applying the sutures. To protect the wound and support the sutures, Senn suggested that a bit of omentum should be applied and stitched to the bowel. But stitches are unnecessary, as the omentum readily adheres to the wound. In the human subject, continuity can be attained by lateral implantation and by lateral apposition as well as by end-to-end approximation. In the first the posterior end is closed by continuous suture, and a hole is cut in the side of the bowel. The anterior end is then passed for an inch into the opening, and fixed by sutures. In the second, anastomosis is effected by means of Senn's perforated bone plates, or slices of raw turnip. The ends of the gut are turned in and closed; each is then slit open at the side about two inches from the end, and a bone plate or a slice of turnip to which sutures have been attached is inserted through the opening. The sutures are then passed through the wall of the gut and tied together to maintain the serous surfaces in apposition.

Cæsarean Section (Laparo-hysterotomy)—The extraction of the fœtus through wounds made in the abdominal and uterine walls.—This operation is indicated, though not always performed, when delivery by the natural channel is impossible in consequence of insurmountable maternal or fœtal difficulty. Introduced with the object of saving the young, the operation at first was only carried out on the dead female. Improved methods and increased confidence, as well as the desire to relieve suffering, suggested the operation on the living with the hope of saving both mother and young.

Recommended by Brugnone and Bourgelat,

Cæsarean section has occupied a place in veterinary practice since the early part of last century. The operation as recorded has been performed fifty-one times altogether—on five mares, twenty-one cows, seven sows, two ewes, and seventeen bitches. Of the mares three were killed, one died, and one survived. Eight of the cows died, seven were killed immediately or soon after operation, and six recovered. Six of the seven sows recovered, and of the bitches four died and thirteen recovered from the operation. Franck, quoted by Fleming, mentions forty-eight cases, twenty-five of which were unsuccessful; and St. Cyr and Violet give a summary of forty-one cases with twenty-eight deaths. These statistics, it must be confessed, are not encouraging, and at first view tend to hinder rather than promote confidence in the operation; but closer examination will show that most of the reports belong to a time antecedent to the employment of antiseptics in veterinary practice.

Recently *Cæsarean Ovaro-hysterectomy*—or extirpation of the uterus with its appendages—has replaced to a large extent the older operation in human surgery. In 1768 the possibility of removing the gravid uterus in animals was proved experimentally by Cavallini of Florence, who operated on dogs and sheep; and similar experiments were performed by Dr. Blundell, Fogliata, Porro, and Rein. In veterinary practice in England the uterus in pregnant bitches is frequently excised. (See "Abdominal Diseases of Dog and Cat," pp. 738-42.)

In performing Cæsarean section, chloroform should be given, and the flank should be prepared and incised as in laparotomy. The incision should measure, according to the case, from five to sixteen inches. Having exposed the womb, it should be incised on its upper surface, and the wound extended by probe-pointed scissors. The fœtal membranes if still intact should be ruptured; and to prevent soiling of the peritoneum a piece of mackintosh cloth should be spread over the lower part of the abdominal and uterine wounds. If the cord can be reached it should be tied and divided before the fœtus is removed. In the bitch, as suggested by Degive, advantage will be gained by bringing the womb as far as possible out of the abdomen before incising the horn. After extracting the fœtus the membranes should be separated and withdrawn through the vagina if possible. The uterine wound should be closed by Lembert's sutures; this done, the womb and adjacent viscera should be douched with warm saline solution. Excess of fluid is then removed by aseptic cotton-wool or sponges, and sutures are placed in the abdominal wound, which is subsequently dressed and bandaged in the usual way.

In hysterectomy, excision has been effected by the écraseur and by the knife, with ligature of strong twist secured by a Staffordshire knot. The stump may be allowed to drop back into the abdomen, or it can be sutured with the wound of the flank, and a few days afterwards set free.

Gastrocentesis.—Piercing the rumen for the relief of tympanites in cattle and sheep has been practised in all countries since very early times. The operation performed with trocar and cannula through the left flank is familiar, simple, and generally successful. A few cases have been recorded in which puncture was followed by peritonitis induced by the escape of gastric contents into the peritoneal cavity.

In 1838 it was suggested that gastric tympany in the horse might be relieved by puncturing the stomach with a long curved trocar and cannula passed through the abdominal floor; but I have not been able to find the report of a single case treated by this method. Gastric flatulence is not a rare condition in horses, but I doubt if the stomach—even when distended and somewhat displaced—can be safely reached through the abdominal wall. In other operations with the trocar there is some degree of certainty that the instrument will directly pierce a cavity or a dilated viscus, but in attempting gastric puncture in the horse the flexures of the colon, and perhaps the spleen, would probably be encountered on the way. The danger of the operation lies not with the stomach, but with other viscera which might be transfixed by the penetrating trocar.

Paracentesis Abdominis.—Tapping the abdomen for the evacuation of ascitic or other fluid. This operation, which is neither difficult nor dangerous, though rarely required in horses, cattle, or sheep, has been frequently performed on dogs. Palliative rather than curative, paracentesis gives the patient ease, and sometimes lengthens life. The puncture may be made inferiorly in either flank. An instrument of small calibre should be employed. In operating on the dog a many-tailed bandage will be found useful to supply counter-pressure as the fluid escapes. Having removed the hair and disinfected the skin, the bandage is applied, and a " window " cut at the seat of operation. The trocar or aspirating needle should be pushed slowly into the abdomen. There is little risk of wounding the bowel, which is generally anæmic and retracted. The escape of fluid may be interrupted by omentum, gut, or solid particles. Whether all or only a part of the fluid should be removed at one tapping is sometimes discussed, but the question is of little moment. With the bandage well adjusted all the fluid may be withdrawn—perhaps with advantage. When it is carefully secured, the bandage to some extent retards reaccumulation, if it does not altogether prevent it. For this purpose, or to arrest the secreting power of the serous membrane, injections of a weak solution of iodine, as recommended by Leblanc more than ninety years ago, have been used successfully by St. Cyr and other veterinary surgeons.

In connection with paracentesis I should mention that uterine and ovarian dropsy has been relieved by tapping through the flank. Steel of Biggar removed 102 quarts of fluid from the uterus of a cow, and W. Field operated twice on a mare, and withdrew altogether 8 gallons from an ovarian cyst.

Enterocentesis—Puncturing the bowel in tympanites.—Vegetius (4th century) recommends abdominal puncture in the treatment of strophus or pain in the belly. Enterocentesis was mentioned by Markham in 1656, and was practised for the relief of tympanites in horses by Roem of Dresden in 1776. Bourgelat and Chabert (1781) operated through the rectum, and Barrier and Herouard—somewhat later—through the right flank. For many years after its introduction, enterocentesis was viewed with much apprehension because of the occurrence of abscesses between the muscles of the abdominal wall and of the frequent deaths, which were often attributed—rightly or wrongly—to the operation. Vatel expressed the fear that peritonitis might be induced by the use of the instrument; and Chabert warned intending operators of the danger of inhaling the mephitic gases, advising the injection into the rectum of "antiputrid" substances—perhaps the earliest suggestion of the employment of antiseptics in veterinary practice. Somehow the operation lost ground and fell into desuetude until 1834, when it was revived by Bernard at Toulouse, and soon after by Rey at Lyons, and by Chabert in Paris. Numerous experiments were made to prove that the horse's bowel could be punctured without danger, and that the formation of abscesses at the seat of operation could be prevented by attention to cleanliness.

In this country the operation was revived—if not performed for the first time—by Stewart of Glasgow in 1836. But Stewart's limited experience, while it startled a few, failed to convince many. The old conservative methods of dealing with flatulent colic prevailed; but treatment must vary with advancing knowledge. Since 1850 enterocentesis has gradually gained the confidence of practitioners everywhere as a ready, harmless, and frequently successful means of relieving tympanites in the horse. The symptoms of the condition are familiar; but sometimes one meets with a case in which the abdomen is much distended, and yet no gas can be found with trocar and cannula. In torsion of the large intestine, when hæmorrhage into the substance of the bowel has occurred, blood may escape from the cannula. The operation, if it fail to relieve distension, may assist diagnosis; more than once a horse has been promptly destroyed when blood instead of gas spurted from the cannula, and in every instance post-mortem examination revealed a hopeless condition of the large bowel.

The seat of operation is the right flank, but the left may be punctured. Rectal puncture, abandoned soon after the decease of Chabert, has been revived by Fohringer and Imminger; against this method may be urged the risk of peritonitis from septic contamination, but with a small and clean trocar the objection may be disregarded. The flank operation, however, is simple and safe.

The complications which attended enterocentesis many years ago were probably caused by want of care in selecting and cleansing the instrument. Trocars of excessive size and in all conditions were employed; and perhaps some of the unsatisfactory operations of the present day might be explained after examination of the instrument. The trocar and cannula, beyond the handle, should be somewhat flattened, and should measure roughly 6 inches by $\frac{3}{16}$ inch. It should be warmed and disinfected before, and cleansed and again disinfected after, the operation. In operating it is advisable to disinfect the skin and to remove the hair, but I must confess to having operated frequently without preparing the skin. To prevent the gut from slipping off the cannula, Brogniez, in 1843, designed an enterotome, which has, however, received little commendation. When employing a fine trocar and cannula I invariably first puncture the right upper-flank; and if no gas escape, reintroduce the trocar four to six inches below the first puncture. In many cases I have punctured both flanks at several places, and in one horse I punctured the right flank in seven places without complication. Beginning at the upper flank, the trocar may be safely introduced at intervals of a few inches downwards behind the last rib to the abdominal floor. I refrain from naming the bowel, because in flatulent colic sometimes one and sometimes another part of the gut is distended and in contact with the flank, and to wait until one can ascertain which bowel is most dilated is neither advisable nor advantageous.

The effects of the operation, when successful, are at once apparent: gas escapes, distension subsides, respiration becomes easier, pain disappears, and the patient recovers.

Before withdrawing the cannula some practitioners pour medicine into the bowel, but this practice is not always free from risk.

J. M.

NEURECTOMY

The neurectomies which are of practical value, and which are commonly performed in equine practice, are five in number, viz.: median, ulnar, plantar, and anterior and posterior tibial.

Of these the median and plantar are the operations which are done the most frequently.

Median neurectomy, originally introduced by Peters of Berlin, was first performed in England in 1894, and is of especial value in obscure lameness proceeding from chronic affections which cause pain on the inside of the limb; such, for example, as chronic periostitis or ostitis, the presence of a knee-splint or one passing under the tendon and causing pressure between the latter and the cannon bone, a sprained and thickened tendon, or an ostitis (or periostitis) of the inside of the fetlock-joint. There is, of course, no good object in depriving the whole of the inside of the leg of sensation when the cause of lameness is definitely below the fetlock, as plantar neurectomy would serve the purpose equally well.

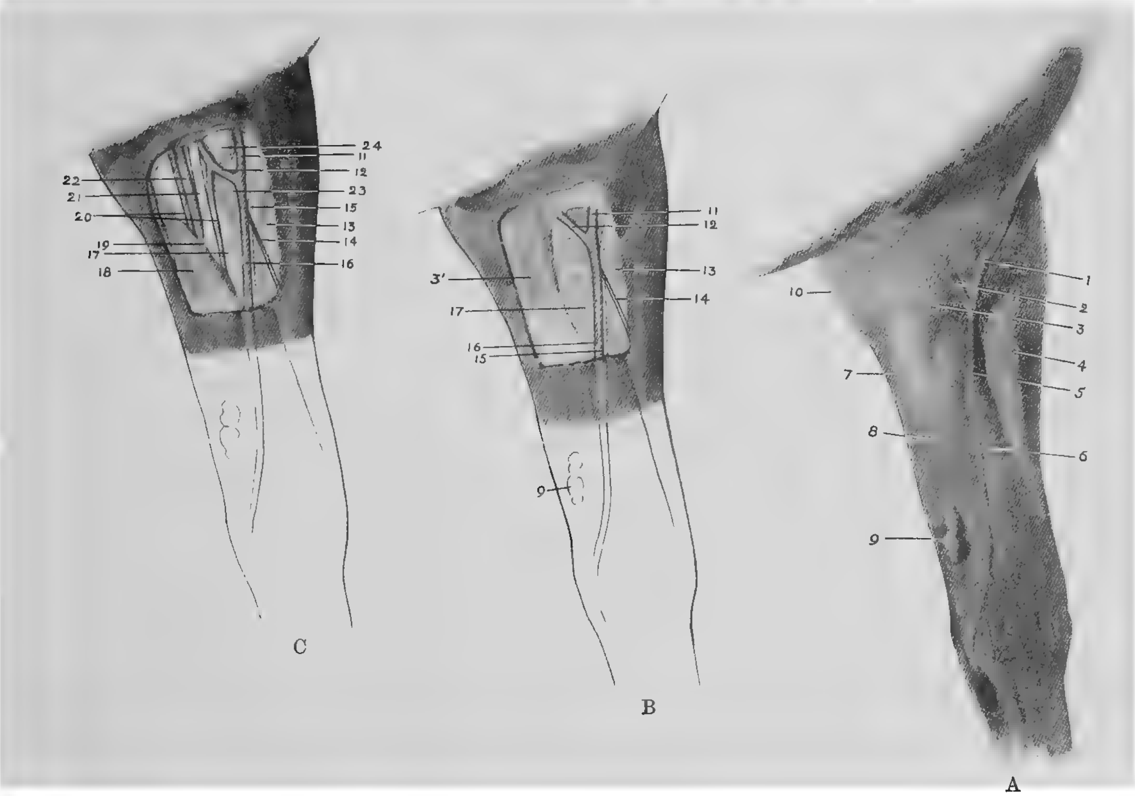

Fig. 319.—Inner side of forearm.

A. 1. Indication of commencement of cephalic vein; 2, indication of basilic vein; 3, muscular portion of posterior superficial pectoral; 4, extensor metacarpi magnus; 5, internal subcutaneous vein of the forearm; 6, inner border of the radius (subcutaneous); 7, dotted line marking convenient spot for performing median neurectomy; 8, position of flexor metacarpi internus; 9, chestnut; 10, line marking the spot where the posterior radial artery can be felt as it crosses the inner side of the radius.

B. 3′, Posterior superficial pectoral muscle exposed; 11, cephalic vein; 12, basilic vein; 13, portion of extensor metacarpi magnus covered with fascia; 14, anterior subcutaneous (radial) veins of the forearm; 15, small branch of the musculo-cutaneous nerve (from the median); 16, internal subcutaneous (median) vein of the forearm; 17, inner border of the radius.

C. 18, Flexor metacarpi internus; 19, muscular branch of the median nerve; 20, radial veins; 21, median nerve; 22, posterior radial artery; 23, brachialis anticus at its insertion; 24, biceps at its insertion.

The operation can be performed under cocaine in the standing posture, but it is much better to cast and chloroform the patient. When the latter is done, the fore leg to be operated upon (the underneath one) is drawn forward and held out straight and in a forward direction by one or two men, being prevented from going too far forward by a loop of rope, one end of which is attached above the knee and the other above the hock; the top fore leg being fixed back out of the way. The operator then, after shaving and painting with iodine (or other antiseptic), feels for the position of the nerve immediately behind the radius and exactly over the thin fan-shaped portion of the fascia of the superficial pectoral muscle. With a scalpel a longitudinal incision is made immediately over this, a very thin layer of it being cut through, and the glistening white fascia of the flexor muscles is exposed. This is quite a tough layer, and needs to be incised very carefully, as the radial vein and artery lie close underneath it, and if injured bleeding becomes troublesome. A careful incision is made with the point of the scalpel and enlarged with the aid of a director to the size of about three-quarters of an inch or an inch. As a general rule the nerve is then in view, and can be exposed sufficiently to pass the tenaculum underneath it. This is then done, care being taken not to injure the vein which lies exactly alongside it, and the nerve is drawn into position for excision ; the latter being done with a scalpel at the upper part. A pair of artery or other forceps is then applied to the distal end of the nerve and a piece about two inches excised. The wound is then sutured, and painted with iodine daily, healing up generally by primary union. Sometimes the animal will trot sound at once, and at other times will not be improved for ten days or a fortnight. If not improved in the amount of lameness it is well not to give a final opinion for three weeks or a month, until the animal has had a trial at work. The ultimate results of this operation, especially upon the heavy breeds and those used for slow work, are excellent. For hunters, or animals required to put sudden strain (such as in jumping) upon the flexor tendons, it should not be performed without first advising the owner clearly that the tendon may give way suddenly under violent exertion.

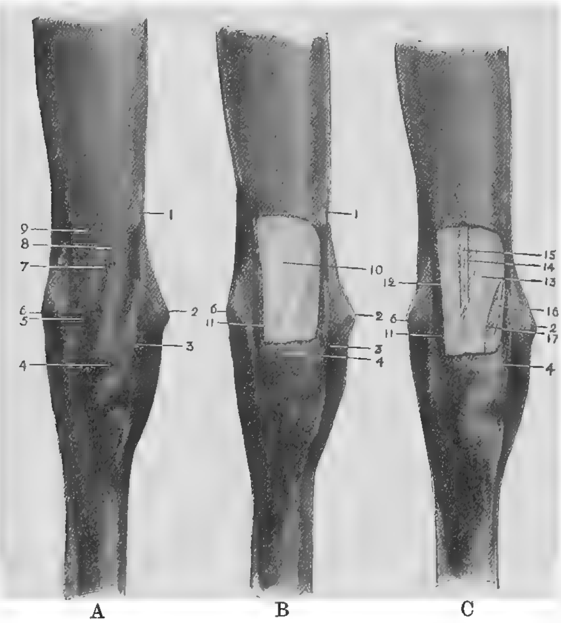

Fig. 320.—Near fore limb. Posterior aspect of knee and forearm.

A. 1, Chestnut; 2, internal tuberosity of radius at its lower extremity; 3, groove marking position of carpal sheath; 4, posterior border of the pisiform bone; 5, lines indicating the location of the cutaneous branch of the ulnar nerve; 6, external tuberosity of the radius at its lower extremity; 7, groove marking the position of the ulnar vessels and nerve, and the separation between the flexor metacarpi externus and medius (or obliquus); 8, flexor metacarpi medius; 9, flexor metacarpi externus.

B. 10, Fascia covering flexors of forearm and ulnar vessels and nerve; 11, cutaneous branch of ulnar nerve.

C. 12, Flexor metacarpi externus exposed; 13, flexor metacarpi medius exposed; 14, ulnar nerve; 15, ulnar vessels; 16, branch of median which passes to join the ulnar; 17, vein of origin of the posterior radial.

Gelatinous degeneration of the flexor tendons, characterized by a swollen condition of the back of the limb, is the chief sequel to be afraid of. Should this occur, the animal should be humanely destroyed.

Ulnar Neurectomy.—This nerve is found at the back and slightly on the outside of the ulnar region, about three or four inches above the back of the knee. An incision is made through the skin and fascia in this situation, and the nerve picked up with the aid of the tenaculum. It is then excised with a scalpel, a length of two inches or so being removed. The wound is then sutured, and treated antiseptically until healing has taken place.

Plantar neurectomy can be performed on any of the legs, but is most commonly used for ailments of the fore feet. When properly performed, the parts below the site of operation are completely deprived of sensation. It can be done in two situations, one above the fetlock (this is the one most usually performed) and one below.

The method of operating is the same whichever is chosen, and it can be done either under chloroform or by the aid of a local anæsthetic. It can be done with the animal standing, but to cast and draw the leg forward is more convenient. For the higher operation the site selected is about one and a half inches above the fetlock-joint, in the hollow just in front of the tendons, the operator recollecting the letters V.A.N.T., which express the order in which the parts are placed (Vein, Artery, Nerve, Tendon), and a useful guide can always be obtained by locating the artery and nerve with the finger at the place where they pass over the side of the fetlock-joint.

With a tourniquet properly applied, especially if Esmarch's bandage is used, the operation is practically bloodless. The skin is shaved and cut through in the place indicated, the white connective tissue is delicately dissected through with the scalpel, and the nerve brought into view. This is then picked up with a tenaculum, cut through at the upper part, and about an inch removed. There is no pain below the incision after the nerve has been cut through. The wound is then sutured, and bandaged or not at the will of the operator, and if it has been rendered aseptic before the operation, it can be made to heal within a week by primary union.

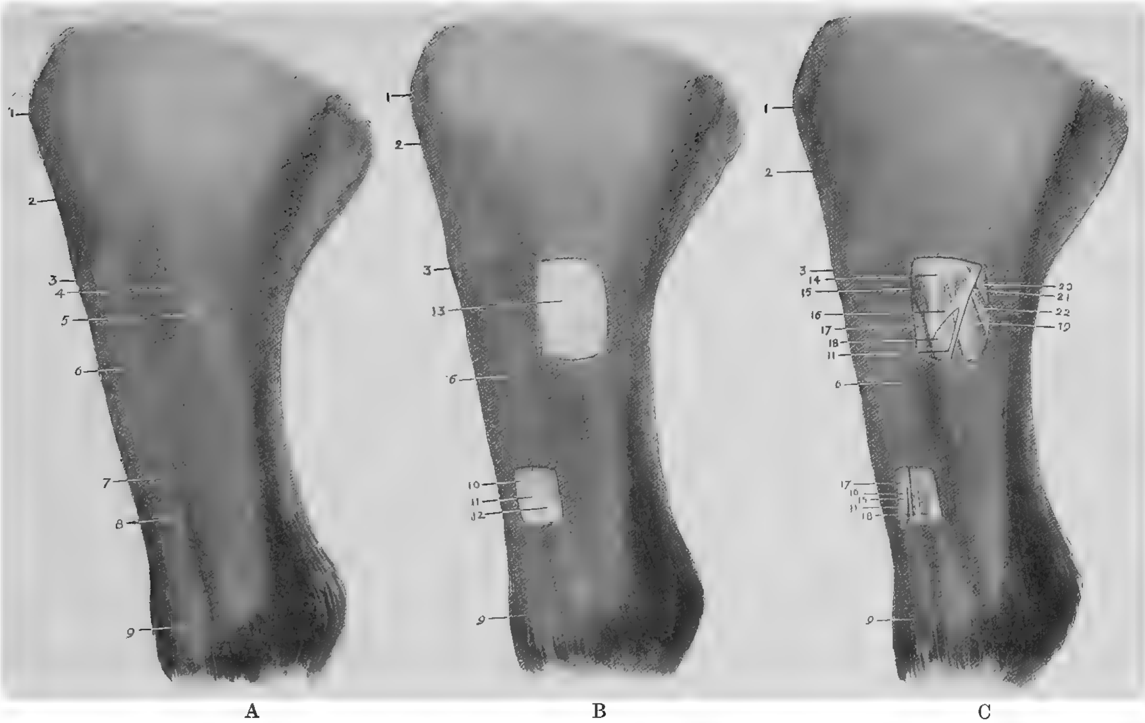

FIG. 321.—Near hind limb : outer side of leg.

A. 1, Patella ; 2, position of straight ligaments of patella ; 3, anterior tuberosity of the tibia ; 4, ridge over peroneus muscle and fibula ; 5, line indicating incision for anterior tibial neurectomy (high operation) ; 6, position of extensor pedis and flexor metatarsi muscles ; 7, ridge over peroneus in lower portion of leg ; 8, line marking incision for anterior tibial neurectomy (low operation) ; 9, external malleolus of tibia (subcutaneous).

B. 10, Extensor pedis muscle seen through the subcutaneous fascia ; 11, musculo-cutaneous nerve ; 12, peroneus muscle seen through the subcutaneous fascia ; 13, fascia over the peroneus.

C. 14, External lateral ligament of the stifle as it lies over the head of the fibula ; 15, muscular portion of flexor metatarsi ; 16, anterior tibial nerve ; 17, extensor pedis muscle ; 18, peroneus muscle ; 19, soleus muscle ; 20, gastrocnemius ; 21, termination of external popliteal nerve ; 22, flexor perforans.

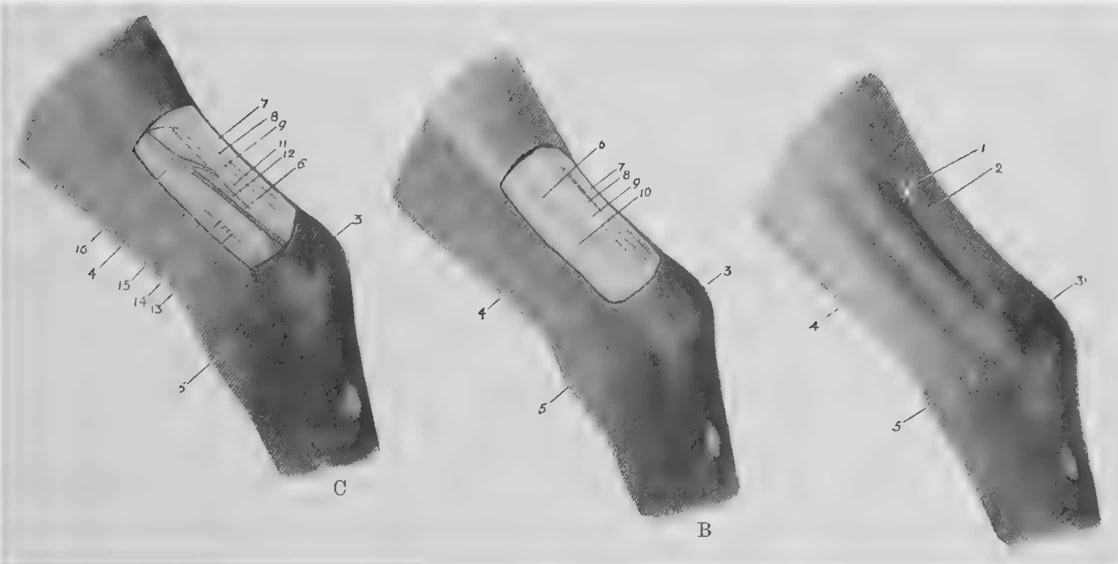

FIG. 322 —Inner side of leg.

A. 1, Line indicating point of incision for posterior tibial neurectomy ; 2, "tendo Achillis" ; 3, point of the hock ; 4, inner surface of tibia (subcutaneous) ; 5, internal malleolus of tibia.

B. 6, Upward continuation of external metatarsal vein seen through the fascia ; 7, gastrocnemius tendon ; 8, flexor perforatus tendon ; 9, strong fibrous band in front of flexor perforatus and gastrocnemius tendons ; 10, subcutaneous strong fascia.

C. 11, Posterior tibial nerve, covering retrograde (small) branch of the posterior tibial artery ; 12, cutaneous branch of the posterior tibial nerve ; 6′, upward continuation of external metatarsal vein exposed ; 13, dotted line mapping out position of posterior tibial artery under the deep fascia and alongside the flexor accessorius ; 14, flexor accessorius tendon as seen through the deep fascia ; 15, inner border of tibia ; 16, deep fascia on inner side of leg covering the flexor perforans and accessorius muscles.

With the lower operation the same method of procedure is adopted, and the situation chosen is just in front of the tendon about an inch or an inch and a half below the fetlock-joint. This operation is only preferable to the higher operation when one is absolutely certain that the cause of lameness lies in the posterior region of the foot.

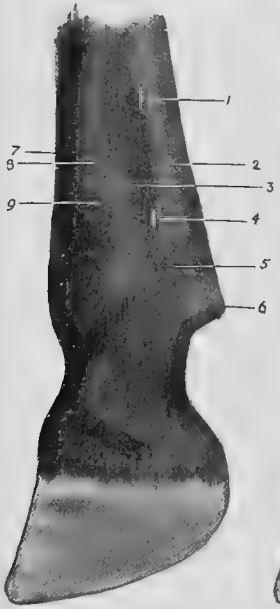

FIG. 323.

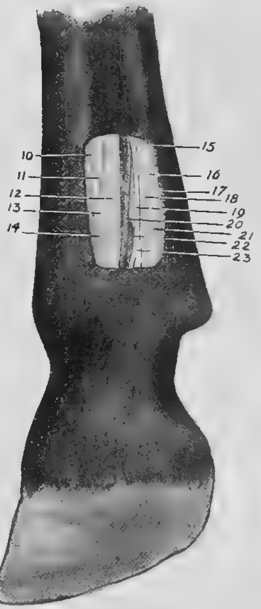

FIG. 324.

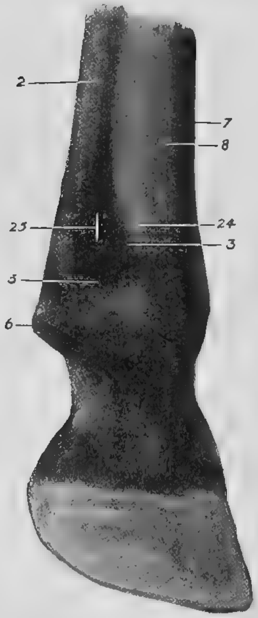

FIG. 325.

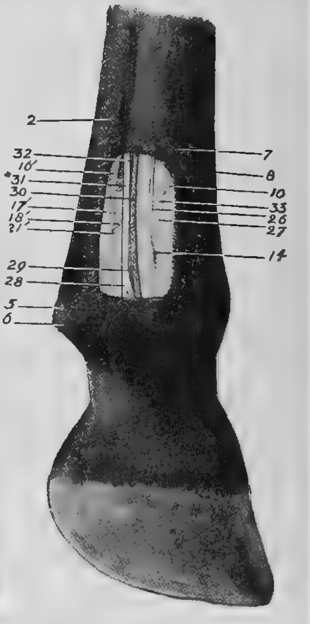

FIG. 326.

FIG. 323.—Outer side of metacarpus.

1, Line indicating suitable position for flexor tenotomy; 2, position of flexor perforans and perforatus tendons; 3, position of suspensory ligament; 4, line indicating position of incision in plantar neurectomy; 5, area where the digital vessels and plantar nerve can be rolled under the finger; 6, ergot; 7, position of extensor pedis tendon; 8, large metacarpal bone; 9, button of external splint bone.

FIG. 324.—Outer side of the metacarpus, dissected.

2 to 9, As in Fig. 323; 10, small portion of large metacarpal bone exposed; 11, external small metacarpal bone; 12, border of suspensory ligament; 13, button of external small metacarpal (splint) bone exposed; 14, area where synovial membrane of the fetlock becomes superficial in front of the suspensory ligament; 15, oblique branch joining external plantar nerve; 16, lumbricalis muscle; 17, flexor perforatus; 18, flexor perforans; 19, external plantar nerve; 20, external metacarpal vein; 21, spot where the synovial membrane of the great sesamoidean sheath is very superficial; 22, digital artery; 23, termination of external plantar nerve.

FIG. 325.—Inner side of metacarpus.

24, Button of internal small metacarpal bone; 25, line indicating point of incision for neurectomy of the internal plantar nerve.

FIG. 326.—Inner side of metacarpus, dissected.

26, Interosseous muscle; 27, button of internal small metacarpal bone exposed; 28, termination of internal plantar nerve; 29, internal digital artery; 30, internal metacarpal vein; 31, internal plantar nerve; 32, large metacarpal artery; 33, internal small metacarpal bone; 14, 16, 17, 18, 21, as for outer side Fig. 324.

Anterior Tibial Neurectomy.—This is performed on the outside of the tibia about six or eight inches above the hock, just behind and underneath the popliteal ridge. It is fairly superficial in this situation and can be felt from the outside. It is cut down upon, and separated out with the tenaculum, about one or two inches being removed. The wound is then sutured and treated in the usual way.

Posterior Tibial Neurectomy.—The incision for this nerve is made about an inch in front of the gastrocnemius tendon, and five or six inches above the point of the hock on the inside. The nerve can be felt by palpation and is almost as thick as an ordinary lead-pencil. Comparatively speaking it is superficial, as it only requires an incision to be made through the skin and one layer of fascia in order to expose it to view. The tenaculum is then brought into use, and a piece about two inches long excised in the usual way. The wound is sutured and treated antiseptically, usually healing by first intention.

Sequelæ.—With all the neurectomies, one should always warn the owner of the animal of the sequelæ which are apt to occur, and neurectomy should never be performed until all other known methods have failed to effect a cure.

Gelatinous degeneration and consequent breaking down of the tendon occasionally occurs, and upon the first sign of this the animal should be humanely destroyed. The first symptom of this is a swollen condition of the part, followed by elevation of the toe of the foot. For animals which do slow, steady work and are not hammered violently along hard roads, neurectomy is an operation well worthy of a trial in obstinate and chronic lameness, especially in navicular disease, sprained tendons, sesamoiditis, splints and periostitis of all kinds affecting the inside of the cannon bone. It should never be done in cases of laminitis. The average working life of a horse afterwards is about two years, but it is always uncertain. It may only last three or four weeks, or it may last for several years, depending upon the effects of work or wear and the re-establishment of sensation.

F. T. G. H.

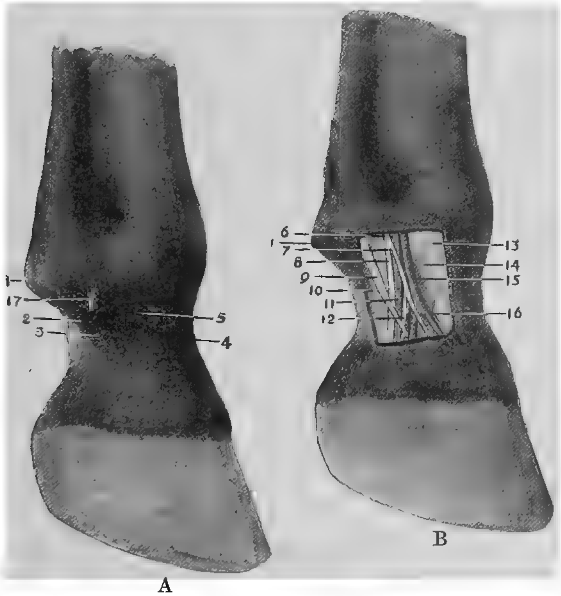

Fig. 327.—Digit from the side.

A. 1, Ergot; 2, position of flexor tendons; 3, position of digital vessels and nerve; 4, position of extensor pedis tendon; 5, position of slip from the suspensory ligament; 17, line indicating incision in posterior digital neurectomy.

B. 6, Termination of plantar nerve; 7, anterior digital nerve; 8, posterior digital nerve; 9, ligament of the ergot; 10, flexor tendons covered with the reinforcing sheath of the flexor perforans; 11, digital artery; 12, middle digital nerve; 13, slip from the suspensory ligament to join the extensor pedis tendon; 14, os suffraginis; 15, digital vein; 16, perpendicular artery.

CHOKING

General Remarks.—The meaning of the word choke, as generally used, implies suffocation, throttling, or strangulation (*strangulo*—I choke). In its veterinary sense, however, it denotes the presence or arrest of a foreign body in the pharynx or œsophagus, thus preventing the animal from swallowing either solids or liquids, or doing so with great difficulty.

Choking varies in degree, depending upon the amount of obstruction caused by the foreign body itself or the tissue changes induced by the presence of the latter in the gullet.

Again, small bodies such as pins and needles may cause complete choking owing to the severe spasms and pains which they induce, or, when they are of a less irritating nature, through excessive irritability of the œsophageal wall. The gullet in all animals is much less liable to inflammation than other parts of the alimentary tract, but it is more exposed to direct injury from substances swallowed. Choking in man as a result of spasm of the muscle of the gullet, apart from the actual presence of a foreign body, sometimes occurs in neurotic individuals, but it is doubtful if this condition is found in the lower animals.

Symptoms of choking may exist, apart from spasm or the presence of any substance or body lingering in the lumen of the gullet, being due to disease of the walls of the latter, or change in adjoining parts, such as an enlarged gland or an abscess either at the back of the throat or lower down in the mediastinum; in such cases swallowed food may accumulate above the affected parts. Normally the gullet is found in an empty condition, it being somewhat intolerant of substances loitering, but Sir F. Smith states that a trifling amount of food may sometimes be found in the gullet of the horse near the stomach. As a rule any substance capable of producing irritation if arrested in its downward course towards the stomach quickly induces symptoms of choking. The œsophageal tissues, however, soon seem to acquire some tolerance to the presence of a foreign body within its lumen, and after the first stage of reaction, so to speak, has passed, and in the absence of inflammation, a substance may long remain in the tube if only partially obstructing it without inducing much disturbance. In man this tolerance is very marked, and a foreign body may lie quiescent in the gullet for many years. In all cases, however, sooner or later it will cause the death of the patient unless removed by nature or art.

This tolerance of the œsophagus to the presence of foreign bodies after the initial and often very severe symptoms have passed or have been relieved should be remembered by those in charge, as indicating in many cases the absence of great urgency in the removal of the offending body, especially when the nature of the latter is doubtful. Its non-recognition has been responsible for many of the catastrophes which have followed too hasty attempts at removing the object, these latter being often both vigorous and crude; especially has this been the case with choking in cattle. Many horses and cattle have been sacrificed in this way, when by judicious waiting all would have been well, and yet it is precisely in cases of choking that valuable assistance can be rendered animals by so-called "first aid," which is not often possible in other accidents or conditions affecting them. From this we may conclude that there is a natural tendency to spontaneous relief in ordinary cases of choking when once the initial severe symptoms, if existing, have been overcome. The choking body, tightly held for a time by the muscular wall of the gullet, is subsequently released, and the local nervous mechanism stimulated by the object in the lumen of the tube starts a peristalsis which moves it onwards to the stomach. We have watched an animal closely at the moment when relief must have occurred, and have not noticed any actual swallowing movements such as would probably occur from impulses sent out from the swallowing centre in the medulla. It is said that after the vagus nerve has been cut for twenty-four hours or more, distension of the œsophagus by food may cause a peristalsis passing on to the stomach. It is possible that the swallowing centre, more or less exhausted by the over-stimulation following the occurrence of choking, is supplemented later by local movements as above indicated. In some cases many hours elapse before these movements become sufficiently powerful or sustained to effect relief, and during this period some change also probably occurs in the foreign body itself by the action of the swallowed saliva or other secretions, and thus favours its being moved on. Sharp, hard, large, or irregularly-formed substances are not commonly removed in this way, and they frequently penetrate the mucous membrane and the deeper parts of the wall of the gullet, thus inducing a spreading inflammation or cellulitis.

A great variety of substances have been met with obstructing the œsophagus of different animals, ranging from a lamp chimney to a whip handle and even a snake. There are two main classes of bodies which cause choking, the sharp wound-producing substance already mentioned, and bodies which are arrested on account of their size, and to these two may be added a third class, those bodies which become arrested through some untoward occurrence during mastication or deglutition. The first two are most often seen in the ox and dog, and the third furnishes the majority of the cases of choking in the horse.

The habits during feeding may favour the occurrence of choking as witnessed in the ox and dog, both being greedy feeders, and these animals may swallow substances readily which would easily choke a horse. The latter exercises considerable caution in prehension, and as a rule rejects unsuitable bodies.

The gullet or grass pipe varies in different animals; its inner lining or mucous membrane is covered by strong stratified epithelium, and when at rest is thrown into folds which obliterate the lumen of the tube. The loose, connective tissue between the inner coat and the muscle wall is noticeable, and its presence adds to the danger of cellulitis following wounds and abrasions on the inner surface of the tube, and similar remarks apply to wounds involving the tissues surrounding the œsophagus itself.

Choking in Cattle.—This is rather a common accident, and is due to several causes some of which have relation to the mechanical condition of the food, and others to the attempts of the animals to swallow bulky substances with insufficient mastication. This latter habit is predisposed to, by the tendency of many bovines to elevate the head and straighten the neck while chewing, and so work the substances between the teeth. With the head thus held and the mouth widely open, bodies get back too far for chewing, and are bolted, only to be arrested lower down the tube and cause choking.

Pieces of turnip, mangold, potatoes, apples, etc., frequently induce this trouble, as also do a great many other substances varying from the recently discharged fœtal membranes to linen articles, bones, sticks, etc. Cases of impaction of the gullet or so-called "dry choking" are rarely or never seen in cattle apart from structural disease of the œsophagus, but we have seen a bullock with its gullet full of green material, the trouble passing away after some days. Foreign bodies which have gained an entrance to the rumen may ultimately be arrested in the œsophagus on their way up or down with the "cud," and thus cause choking. Irwensen found a hair ball in the gullet of an ox eructated from the stomach, and we once saw a small cannula, of the kind used for tapping horses, introduced to relieve the urgent tympany in a choked ox. The strong rolling action of the rumen broke the cannula about the middle, and the distal part passed into the stomach. Some days later when the beast was slaughtered, the tube was found in the cervical portion of the gullet.

The seat of obstruction in a case of choking may be at any point between the pharynx and the stomach, being most common close behind the pharynx, or at the lower part of the upper third of the gullet. Many cattle have a habit of picking up odd articles in their mouth, and sometimes attempt to swallow them, thus getting choked.

In mining districts where old wire rope is used for fencing, the pieces from broken strands fall on the grass and are taken in by the animals during grazing, causing symptoms of choking and ultimately inducing pericarditis.

Symptoms.—The beast stops feeding, is restless, coughs, and gasps, and may attempt to vomit. There is an abundant flow of saliva which is ejected along with any unswallowed food present in the mouth. The distress continues and tympany is soon manifest. The severity and duration of the symptoms will depend largely on : (1) the size, nature, outline, etc., of the foreign body inducing the choking; (2) the quantity and nature of the contents of the stomachs, and (3) the degree of reaction to the presence of the foreign body by the master tissues concerned, nerve and muscle. An outstanding feature of choking in cattle is usually the rapid onset of tympany (hoven) affecting the rumen. This quick distension of the stomach with gas is usually said to be due to the presence of the foreign body not allowing the normal eructation of gases by way of the gullet ; but the sudden arrest of normal digestion probably also plays an important part in favouring the formation of an unusual amount of gas. This tympany may quickly threaten the animal's life, and it demands prompt relief. The tendency to stomach distension in such cases is greatest immediately following the arrest of the foreign body in the tube, and it gradually becomes less marked as time passes. There is no doubt that the reaction of the neuro-muscular mechanism of the œsophagus varies greatly in different animals, and is not altogether due to the size and nature of the offending body itself. The latter, however, if large and lying at the entrance of the gullet, always induces distressing symptoms. The animal may be almost suffocated, gasping and coughing, with other movements suggestive of distress. In many cases, however, when the object is arrested lower down, the symptoms will be comparatively mild, especially in lean cattle, and at no stage assume a threatening character. In such cases there is a low degree of irritability of the parts, and the spasm or reaction is slight. The animal may take water, which is presently ejected with but little distress, some, perhaps, passing on into the stomach. Here, also, saliva to some extent will pass down, assisting to macerate and loosen the body, thus preparing it to be passed on with the development of sufficiently strong swallowing efforts on the advent of local peristaltic movements.

Various methods are adopted in the examination of a beast affected with choking:

By direct examination; on passing the hand through the mouth one may locate the foreign body in the pharynx or impacted in the upper end of the gullet, and at the same time withdraw it.

Animals often greatly resent this method of examining the throat from within, especially if there is any respiratory distress, as they seem to have a sense or dread of impending suffocation. A good gag or mouth speculum should be used, and there should be room behind the examiner.

When the arrest has occurred in the neck the object can usually be felt on the left side in the jugular furrow, by palpating the parts, and here we should not mistake the larynx for a foreign body.

The diagnosis of choking when the substance is lodged in the chest is a more difficult matter, and one has to depend upon the history and general symptoms presented, while the careful passing of a probang may assist in forming an opinion.

Choking may always be suspected in the presence of attempts at vomition, retching, profuse salivation, ejection of fluids, and tympany.

Course.—In many cases of choking relief takes place spontaneously with the disappearance of the tympany. The latter when severe is not only dangerous to life, but the distended stomach by the pull it exerts on the gullet prevents any relaxation of the walls of the latter. Similarly a gag placed in the mouth affords relief by diminishing the length of the gullet, and thus incidentally favouring its relaxation. Large bodies impacted at the entrance of the gullet may cause sudden death from dyspnœa, and attempts at swallowing the afterbirth may kill in this way ; œdema of the glottis is also sometimes seen. Rupture of the walls of the gullet with resulting cellulitis is somewhat frequently met with in cattle ; formerly, when nearly all choked animals were promptly "tubed" in some way or other, it was a very common occurrence. Rupture may occur quite early apart from the use of the probang : two such cases occurred within fourteen days of each other in a house containing eight large bullocks. Their neck-chains were rather tight and short, and they were being fed with whole mangolds : the choked beasts, blown and distressed, endeavoured to free themselves, and the resulting neck pressure induced rupture of the tightened œsophagus. Both animals were slaughtered within eighteen hours of being choked, and a piece of mangold was found in each at the seat of the lesions. There is a tendency to recurrence for a time when choking has once occurred, and there is an increased liability to rupture in such cases.

We have seen instances when an animal has been slaughtered after a second choking, and the injury resulting from the first accident could be plainly seen. It is astonishing how soon the neck begins to swell in cases of rupture of the gullet, and how serious the result may be in a few hours, especially so in the case of fat cattle. Any swelling in the neck or chest following symptoms of choking may be taken as almost certain evidence of a lesion in the gullet, especially if there are any indications of gas (emphysema) accompanying the swelling or œdema of the neck. In such cases the animal should be promptly slaughtered if it has any food value: we have seen the tissues of the neck in quite a putrid condition eighteen hours after the first onset of symptoms of choking. In fat animals particularly the loose connective tissues surrounding the gullet form an excellent breeding-ground for organisms, anaerobic and otherwise. The emphysema when present is usually regarded as resulting from gas from the rumen passing through the rent in the tube, but it is often associated with the growth of gas-producing organisms in the tissues of the neck.

Gas may be absent from the swollen tissues in cases in which a large rent is subsequently found in the tube, and in other cases there may be evidence of an extensive collection of gas in the upper portion of the neck, and at the post-mortem one finds that the œsophageal wall has not entirely given way, but that a condition like gangrene exists, extending right along the channel of the neck. One has only to compare the mildly irritating nature of the gas, etc., escaping from the rumen when the latter has been punctured with a knife in the upper part of the left flank, as shown by the absence of inflammation subsequently from the parts, with the rapid onset of gangrene in the neck resulting from the entrance of similar material into the tissues through a rent in the gullet. In such cases the gas when present tends to rise to the upper region of the neck and form a balloon-like swelling around the throat, while the serum poured out in large quantities collects in the mediastinum, where it not only embarrasses the heart and lungs, but forms a depôt from whence infective material is quickly carried to other parts. Such cases are always fatal, but the rapid downward course following a rupture of the gullet as sketched above occurs chiefly in fat and stall-fed cattle, and all degrees of infection may be met with in store and lean animals.

Where turnips are very hard and cattle receive them sliced, the pieces having sharp points, the latter may easily puncture the wall of the gullet causing a slit on the way down, and no symptoms of actual choking may be noticed at the time. In such instances a gradually-increasing swelling of the neck is the first indication of anything being amiss.

Pregnant cows may abort as the result of the extreme distension of the rumen causing the death of the fœtus, and other results of choking are inflammation of the walls of the gullet and subsequent contraction. Broncho-pneumonia, septic and otherwise, may also follow, especially when the animal has been given brine with a view to relieving the choking, since salt in strong solution seems peculiarly liable to cause spasm of the glottis in cattle. The terminations are those pertaining to accidents or disease of similar structures or channels in other parts of the body.

As regards the prognosis generally in cases of choking in cattle, it must be considered fairly good if the case is properly managed, and no bungling attempts are made to force either tubes or irritating fluids down the course of the gullet.

Treatment.—Prevention.—As choking is more liable to occur in cattle when they masticate with the head well up, a bar may be placed across the feeding place so as to prevent them raising the head. Roots may be pulped or finger-sliced, and this should always be done for a few days after a beast has suffered from choking, and for reasons given above pointed pieces are to be avoided. It is difficult to prevent cases of choking when potatoes, apples, or small roots are thrown about on the ground, and the animals feeding under such conditions should be frequently seen.

In choking, severe symptoms may manifest themselves almost at once, and the owner or attendant will have to give "first-aid" or the animal may succumb. The beast should be turned loose if stall-tied, and the rumen should be punctured whenever tympany is severe; in the absence of a trocar and cannula a sharp knife may serve in an emergency, taking care to keep the instrument well away from the left kidney. A piece of wood to act as a gag may also be placed in the mouth of the animal, maintained in position by a cord passed around the base of the horns. With the gag in, the head is carried in the best position to afford relief. The operation of tapping is the most important procedure in the management of a case of choking in the ox, and it should be carried out even when the tympany is mild; in such cases a strong instrument of small bore may be used, and allowed to remain in as long as necessary. A small cut is first made in the skin to facilitate the introduction of the instrument.

Having adopted these measures the majority of cases of choking in the ox will recover in the course of a short time, and nothing further should be attempted except at the hands of a professional attendant. Other cases, however, will require further handling, and various measures may have to be carried out.

Direct or Manual Extraction.—If the obstacle is lodged in the throat, or can be felt impacted in the gullet, an attempt should be made to remove it through the mouth. A good gag should be used, the head steadied by two assistants, and the examiner, holding the tongue with the help of a cloth with the left hand, uses the right one to explore the throat internally.

Some animals will resent this examination strenuously, and especially if there is any difficulty in breathing. In such cases if there is any danger, and relief is urgent, a preliminary tracheotomy may be performed. It is remarkable how much more easy it is to manipulate the throat internally when the animal has a tube in the trachea, and the operation is so easy to perform and free from objection that no risks need be run as regards asphyxiating the animal, or from the latter injuring the attendant in its struggles.

We have often adopted this plan before opening an abscess in the pharynx of cattle or removing a polypus therefrom.

Taxis or External Manipulation.—This is useful in cases of upper cervical choking. The animal's head is depressed, the mouth kept open and pressure exerted with the fingers on either side of the neck behind the obstacle, the operator taking care to avoid being injured by the horns of the animal. If the body move upward the pressure should not be relaxed until it has entered the mouth or falls out. In cases where the choking is lower down the gullet, external manipulation is not of much use and must be carefully carried out if at all.

Use of the Probang.—In former days nearly every case of choking had something or other promptly pushed down the gullet, and often with disastrous results. A probang should not be passed if the rumen is distended with gas. We have seen this attempted, unsuccessfully; the rumen was then punctured, but before one could again pass the probang the cause of the choking had disappeared.

If the probang be used, it should be in good condition, about six feet long and not too small. An attendant should be on each side with one hand to the horn, the other holding the gag; the head of the animal is kept straight, and care should be taken to have plenty of room. The probang well lubricated is passed down with caution, and if any obstruction is met with, a moderately increasing pressure, with some give and take, may be tried. If this fail, and especially if the animal be restive, it is better to desist, for there is reason to think that the greater number of cases susceptible of relief in this way would be relieved naturally some hours later. Nothing therefore should be done in a case of choking which will in any way prevent this natural relief taking place. Damage to the wall of the gullet is so easily inflicted that too much care cannot be observed. The absence of blood around the end of the probang when withdrawn does not negative the existence of rupture, but its presence there is very significant. The use of all corkscrew arrangements, snares, forceps, etc., with a view to withdrawing bodies through the mouth, is to be avoided, as their field of usefulness is extremely narrow and the risk of their doing injury is very great. Their rational use demands direct illumination of the œsophageal canal so that the operator may see what he is actually doing, a procedure hardly practicable at present, at least in the case of the ox.

The use of a probang if an animal has been choked some days is not advisable, or if any inflammatory swelling exists along the tissues of the neck.

Medical Treatment.—Lubricants, such as lard or oil, may be given in small amounts, but care must be taken lest broncho-pneumonia result. The hypodermic injection of agents which control spasm is sometimes useful; pilocarpine, eserine, arecoline, morphine, and especially apomorphine, have been used in this way. Chloral hydrate in solution to overcome the spasms may also be given, and preferably through the cannula directly into the rumen. In this way also one may relieve the thirst of the animal, which is so distressing in some of these cases, and milk or gruel may be substituted if food be demanded. A choked animal soon presents a sorry appearance; the eyes are sunken, the abdomen in the absence of gas is tucked up, and there are muscular tremors. These symptoms are greatly improved with an increase in the volume of fluids in the body, and the excretory organs will the better perform their functions.

Operation.—If the carcass value of the animal be small or other reasons obtain, an operation may be performed in a case of unrelieved cervical choking. An incision is made directly over the foreign body and the latter removed. For reasons already given, particular attention must be paid to the drainage of any wound in connection with the gullet, and the leaner the beast the more hopeful the result. Secondary suture is better than a too hasty closure of wounds, seeing that the latter will probably have some dead spaces in them and that they are inflicted in an area where infection is so difficult to prevent.

Choking in the Horse.—This accident is less common than in the ox, but it is a rather more serious condition. The equine œsophagus is relatively long and narrow, and the walls strong and thick, particularly between the diaphragm and the entrance to the stomach. The anatomical arrangement of the parts here renders vomition very difficult, and at the same time also predisposes the animal to choking at this point. Material ejected from the gullet of the horse passes out by way of the nostrils owing to the arrangement of the palate, but occasionally some of it appears to reach the mouth.

Foreign bodies are not often lodged in the pharynx of the horse, but we have found them impacted at the entrance to the gullet. A common point of arrest is at the upper part of the middle third of the neck. Balls or capsules given to horses are often stopped at this point for a short time. We have seen them remain for fifteen minutes without the animal showing the slightest inconvenience.

Choking also occurs in the thoracic portion of the gullet with some frequency, especially with hard substances such as onions or carrots. It is here also that the form of choking due to constriction and diverticula commonly arises. The feeding habits of the horse help him to reject or let fall substances unsuitable for swallowing, while the ox is liable to pass on everything once it is in the mouth. The chief difference in choking in these two animals, however, is the greater tendency to impaction of the gullet with food in the horse—"dry choking." Greedy feeding, old age, or teeth irregularities play a part in bringing about this condition, and especially is it liable to happen when such animals are over-tired, or have been long without food, and the condition may become serious. Offering thirsty animals water when their mouths are full of food is dangerous. We recently saw a bad case of choking induced in this way ; a piece of mangold went on with the first gulp of water and it was arrested low down in the gullet, where it remained eight hours, causing very severe symptoms during the first part of the time. All sorts of substances have become arrested in the gullet of the horse, and it is unnecessary to allude to them here in detail. Organic change in the wall of the œsophagus and associated structures is sometimes responsible for the condition of choking, and constriction at one point of the tube often leads to dilatation of the parts above, where a sort of reservoir is formed and filled with the swallowed food. This latter may be subsequently passed on to the stomach or again ejected through the nostrils. Paralysis and enlarged glands may induce choking, as also wounds in the neighbourhood of the gullet. Horses may be readily choked, in the strict sense of the term, if care is not taken when drenching them, especially if their throat is sore. We recently saw quantities of milk and other fluids come through a tube inserted in the trachea every time the animal drank, and this continued for some days. The horse rarely coughed, and seemed little disturbed by the fluid entering the larynx, neither did the lungs become affected, although it is highly probable that some of the fluid must have frequently reached the chest. It is to be remembered that when being drenched the horse's head is in precisely the position to favour choking, as we have already seen to be the case in the ox. Cases of choking have occurred through drenching an animal when it has been holding in its mouth a ball given previously, and care should be exercised in this respect.

Symptoms.—The indications of choking in the horse are largely those seen in the ox. The attempts at vomition are more pronounced and severe, the neck is arched, the head depressed, and the body drawn up. The animal makes a noise sometimes almost like a scream, and the muscles of the neck and throat are violently contracted. Tympany rarely becomes rapidly dangerous, but it is sometimes noted; the breathing is usually disturbed and there are fits of coughing. Liquids and solids may both be expelled with some force through the nostrils and much saliva is lost. The animal paws the ground, partial sweating may occur, and there is an anxious expression of countenance.

As in most other animals, the symptoms are usually acute and severe immediately after the arrest of the foreign body, and then gradually moderate. In this way diagnosis may be difficult if the animal be not seen until some time after the occurrence of the accident. If the body be lodged in the cervical or neck portion of the gullet it can be more easily felt than in the ox. In the subacute or chronic forms of obstruction in the horse the severity of the symptoms will depend on the degree of impaction present. After some of the impacted material has been got rid of, relief is obtained, the animal begins to feed again, and the symptoms will shortly recur.

Course.—In many cases relief is obtained spontaneously, the solid body is passed on or the impacted material is loosened, some reaching the stomach, other portions being coughed up. If the natural efforts or those of the surgeon are unsuccessful a fatal issue occurs sooner or later from pneumonia, or septicæmia results from infection developing at the seat of obstruction.

Again, the animal may die early from asphyxia or later from inanition and exhaustion.

Diagnosis.—In the ox, chronic disease may induce conditions in which symptoms are observed suggestive of choking, but in the horse it is the acute sore throat which so often accompanies various febrile affections, and some difficulty may be experienced in arriving at a decision. The history of the case should always be carefully inquired into where any doubt exists.

Treatment.—Avoid raising the head and pouring fluid of any kind down the throat. If a foreign body is suspected to exist in the pharynx, or at the entrance to the gullet, the parts should be examined and extraction attempted by the hand. If asphyxia is threatening perform tracheotomy, which will also facilitate the examination of the parts. Hot water applied to the neck may relieve spasm and pain, and this can be further helped by some form of hypodermic medication. The administration of small capsules containing lubricants such as liquid paraffin or fat may be tried, and the general comfort of the animal attended to as regards location and body heat. At a later stage fluids may be introduced into the rectum to relieve thirst, etc. Apomorphine administered hypodermically in a half to one and a half grain doses has been highly spoken of by some. Corm of Ohio states that it induces marked retching, and contractions may be seen passing down the œsophagus much the same as in drinking water. This lasts from thirty to forty minutes, and commences about fifteen minutes after the injection. The effect of atropin in causing dryness of the throat is objectionable, and similarly the use of agents like pilocarpine which greatly increase the flow of saliva may add to the distress of the animal. Eserine is, however, useful in cases of choking in the horse if there is a tendency to tympany.

Instrumental Aids.—If the methods of treatment suggested fail and the animal has been given time, other measures may be necessary. The use of the probang in the horse is not easy, and is more dangerous than in the ox. We have not seen great benefit from its use, and we regard the passing of all tubes or sounds in cases of choking as more or less experimental and beset with pitfalls. If an object can be located in the neck and is otherwise irremovable, it may be extracted by performing œsophagotomy.

Choking in the Dog and Cat.—Various substances may cause choking in the dog and cat, but smooth, round objects are seldom found obstructing the channel. Lumps of food arrested in the pharynx are usually quickly ejected by way of the mouth. Pieces of bone irregular in shape, and with sharp outlines, may become fixed, and cause choking; fish-bones, needles, safety-pins, either open or closed, are common causes; stones, buttons, balls, corks, and such-like objects are to be looked for, and pieces of wood may also be found. Many of these, especially needles, pins, etc., become arrested in the pharynx, often close under the epiglottis, but may be stuck in any part of it. The upper portion of the gullet is narrowest, and this is the most usual seat of choking, the next common point of arrest being at the lower part of the neck and further on just before the œsophagus opens out to enter the stomach.

Symptoms.—Frequent attempts at swallowing alternated with efforts to vomit, salivation, return of fluids given or swallowed, restlessness, coughing, and general distress. Local manipulation causes pain. Thread attached to needles may be seen in the mouth, or other indications of a foreign body noted. Externally the impacted body may be felt and the parts adjoining seen to be in a swollen condition. Sharp bodies penetrating and lacerating the walls of the gullet may induce ulceration, perforation, and death from hæmorrhage owing to a large blood-vessel being opened, or from suppurative cellulitis. Large bodies impacted at the entrance to the gullet may cause death from dyspnœa, and if the obstruction is not so great œdema of the glottis is likely to supervene. Bodies once entering the stomach usually give no further trouble; occasionally, however, serious results ensue. Late serious symptoms may sometimes follow the carrying out of heroic measures or explorations either for arriving at a diagnosis or relief of the choking. The use of a sound or any prodding for diagnostic purposes when a sharp body may be lying in the gullet is likely to do harm. Where the dog is a valuable one and means are available, the assistance of radiography should be had recourse to. The most perfect means of diagnosis, however, consists in the adoption of endoscopic methods enabling a direct inspection or view of the impacted body to be made. The use of direct illumination in exploring the œsophagus has so far not been attempted in the case of animals, but it would appear that the question is purely one of expense, and in the case of valuable dogs should not be impossible.

Treatment.—Foreign bodies located in the pharynx or entrance to the gullet may be removed with long forceps. If the obstruction be lower down the use of emetics is not likely to be successful, and may do harm. If the nature of the obstacle be known and has no sharp edges or points likely to tear, a probang of suitable size may be passed. The mouth of the animal is kept open with a speculum, and the instrument lubricated before use with vaseline or melted butter. The expanding probang as used in man is commonly adopted in canine surgery; the expanding portion is made of thick loops of horse hair, and various sizes are obtainable. This instrument was formerly used to withdraw fish-bones, needles, pins, etc., lodged in the gullet of man, but it is now largely supplanted by the œsophagoscope whenever possible by specialists in throat surgery.

By its means foreign bodies, growths, strictures, etc., can be seen, and treatment controlled by direct vision can be adopted. It is better to desist than to continue pushing blindly a substance of unknown nature along the gullet, with the probable result of lacerating the tissues, and then directly bringing about a fatal termination. Alluding to the matter, Mr.

Herbert Tilley, F.R.C.S., says: "Blind groping in these regions has been responsible for an appalling number of fatalities. For this reason coin-catchers, umbrella probangs, and such like, should be relegated to the historical sections of anatomical museums."

If the body is so firmly fixed that it is impossible to remove it otherwise, it should be cut down upon and taken out. The operation of œsophagotomy, or opening the gullet, has been fairly successful in the dog, and is not very difficult.

Rectal feeding may be had recourse to for a few days, and any food given by the mouth must be limited in amount, and consist of milk, soups, jellies, etc. Complications must be dealt with as they arise. Bodies impacted near the cardiac orifice of the stomach may possibly be removed by opening directly into the stomach and reaching them from the distal end of the tube. F. T. H.

HYDROCELE, ORCHITIS, SCIRRHOUS CORD

Hydrocele

An accumulation of fluid within the tunica vaginalis reflexa.

A similar condition may affect the spermatic cord itself, either in the form of a cyst or as a collection of fluid in the cellular tissue of the cord, between the layers of the tunica vaginalis propria (spermatocele).

Hydrocele is not a common condition in the domesticated animals, although a *slight* excess of fluid is not uncommonly met with when castrating, and is discharged with some force when the testicle is firmly held and an incision made through the scrotum. The origin of hydrocele may be congenital or it may develop even late in life as a result of orchitis, injury to the cord and its membranes, or possibly owing to structural or functional changes occurring in the tunica vaginalis.

Congenital hydrocele is often associated with inguinal hernia in foals, and may be due to escape of peritoneal fluid into the sac of the tunica vaginalis through the over-dilated internal abdominal ring.

There should be but little difficulty in distinguishing between hydrocele and uncomplicated hernia. The former usually forms a pear-shaped swelling easily compressible and free from tenderness or pain. Excepting when the amount of fluid present is very great or when spermatocele exists, the swelling tapers away from below upwards and at the abdominal ring the cord may be felt to be normal in size. In hernia the greatest swelling is at the upper end of the cord; it is usually more or less incompressible, and the size of the enlargement often varies from time to time and may even disappear entirely for a period.

Hernia can often be reduced, but it must be remembered that hydrocele when congenital can be caused to disappear momentarily by pressure, the fluid contents returning to the peritoneal cavity and again trickling back when the hand is removed.

The testicle is easily felt at the lowest part of the scrotum in hernia, but in hydrocele, being surrounded by fluid, often in considerable quantity, it may be difficult or impossible to detect.

Treatment.—When called for, either from absolute necessity or from desire on the part of the owner to remove an eyesore which depreciates the animal's value, treatment must be operative. External applications seldom bring about any marked improvement.

Puncturing the swelling in a number of places with a large needle may permit the fluid to escape into the cellular tissue of the scrotum whence it is absorbed. This treatment is often only palliative. Radical treatment consists in puncturing and withdrawing the contents by means of a trocar and cannula, and subsequently injecting an irritant fluid which will set up inflammation and prevent fresh exudation.

Formerly equal parts of port wine and water were successfully employed. Zinc sulph. ʒi. in water ℥viii. is also sometimes successful. More recently iodine solution has been used. Two per cent solution of iodine in water with the addition of 4 per cent pot. iodid. or one part of tinct. iodi to three parts of lukewarm water make suitable injections. Lime-water has also been recommended.

Considerable swelling usually follows, but disappears in a few days or a week. The operation may be repeated every three weeks until a cure is effected.

As a rule the condition recurs after a short period. R. H. S.

Orchitis

Inflammation of the testicle is quite a rare condition among the domesticated animals. In man its most common origin is urethral infection, but as specific disease of the generative organs, with the exception of dourine, is uncommon in our patients, we must seek other causes. Traumatic injury may be responsible in many cases, particularly in the dog, and in the horse orchitis has been known to follow influenza, whilst abscess formation may in extremely rare instances occur in the testicle during an attack of strangles. As the majority of colts are castrated as yearlings a comparatively small number of entire animals become affected with the disease, and so secondary lesions in the testicle are rarely met with. Pyæmic abscesses may also occur in this region from infection with other pyogenic organisms.

Tuberculosis and glanders also are occasionally met with affecting the testicle.

Symptoms.—These vary considerably according to the actual cause and whether the condition is the result of infection or traumatism.

The principal symptom is swelling of the testicle. The enlargement may be confined to this organ or it may extend to the tunica vaginalis and the scrotum (periorchitis). When the inflammatory symptoms result from external violence, all these tissues may become involved and adhesions may occur between them, or the inflammation may subside without complication. Hæmorrhage sometimes takes place into the tunica vaginalis (hæmatocele) or blood may be extravasated into the spermatic cord. In most cases, however, absorption occurs naturally unless there be wounding of the scrotum with resulting infection from without.

Abscess formation within the testicle is practically always accompanied by periorchitis. In favourable cases the pus makes its exit through the scrotum, which will have by this time become adherent to the tunica vaginalis and testicle. In other instances infection will extend into the spermatic cord and will give rise to fatal peritonitis.

Chronic orchitis is sometimes associated with tuberculosis, more rarely with glanders. There is usually swelling of the testicle with induration, and frequently the tunica vaginalis becomes distended with serous fluid (hydrocele).

In acute orchitis severe pain is always manifested, and in the horse the early symptoms may be mistaken for those of colic. When the testicle is enlarged the gait becomes straddling and movement is restricted. Fever is usually present, especially when infection occurs.

In cases of chronic orchitis pain may be absent, and the only inconvenience to the animal may lie in the size and weight of the scrotum and its contents. We have observed unilateral tuberculous orchitis in a donkey in which the scrotum was of the size of a football, though the greater portion of this swelling arose from hydrocele.

Treatment.—In acute orchitis an aperient should be administered at once, and sedatives and febrifuges may be employed as required.

In traumatic orchitis the scrotum should be suspended by a many-tailed bandage, and should be surrounded by a warm kaolin poultice (prepared by rubbing down powdered kaolin in a mortar, with hot water and treacle or glycerine, into a soft paste). Some practitioners prefer cold applications and astringent lotions. Belladonna relieves pain to some extent and may with advantage be combined with iodine and camphor in an ointment mixed with an animal fat, as lard or lanoline.

Septic orchitis and enlargements arising from tuberculosis will only be benefited by castration, though the operation entails considerable risk, especially when periorchitis exists. At any rate, animals so affected are seldom useful, and the value of the operation usually justifies the risk.

In acute cases Moller recommended deep scarification followed by antiseptic treatment.

In human practice strapping the testicle with adhesive plaster as tightly as can be borne helps to remove the enlargement resulting from orchitis. The operation should be commenced around the cord immediately above the testicle. The other layers are applied, each below and overlapping the last. This method has been recommended for veterinary patients.

R. H. S.

Scirrhous Cord

Scirrhous cord is a chronic enlargement of the divided end of the spermatic cord, developing after castration.

A considerable amount of thickening is not uncommonly met with after the operation. It may always be detected upon palpation during the succeeding week, and generally decreases until about the second or third week, when healing will usually be complete.

When scirrhous cord occurs instead of this, a fistula remains which discharges a thick creamy pus. At the same time the cord becomes gradually larger. The discharge of pus may cease after a while and the fistula may close, without, however, any diminution in the size of the enlargement taking place. The latter may at this stage be of the size of an egg or a tennis-ball, very hard, and in all probability adherent to the scrotum. Sometimes a doughy or even fibrous swelling occurs simultaneously in the same side of the sheath, which thus becomes noticeably deformed.

After a period varying from a few days to months, suppuration will occur in a fresh area within the enlargement, and after a time will break through the skin of the scrotum, giving rise to a fresh fistula.

The enlargement continually increases in size and may weigh anywhere from a few ounces to a hundredweight. In the larger specimens the bulk of the swelling usually lies within the abdomen, to which region it has extended through the inguinal canal.

Rectal exploration affords valuable information as to the extent of the enlargement, and whether it is in part contained within the abdomen, though the limits of growths of moderate size can be determined by palpation of the scrotal region.

During the acute inflammatory stage, and when suppuration is in progress, the animal exhibits symptoms of pain and soreness when the parts are handled, and he may show mild fever and a varying degree of lameness. The limb of the affected side is abducted and carried stiffly forwards with a shortened stride. These symptoms are much more in evidence when the animal is travelling downhill, particularly when forced to keep back a load.

In other cases the growth appears to reach a certain stage of development and then becomes chronic, and may thus remain indefinitely, unless any circumstance should arise which might lower the natural resistance to the infection. A large number of horses are thus affected, and since the days of castration in the standing position, particularly in districts where the operation is performed by amateurs whose surgical outfit is often limited to a clasp-knife, a pair of bent hazel twigs, and some binder-twine, cases of scirrhous cord are more common. In conducting examinations as to soundness we may frequently meet with unsuspected scirrhous cords, which have apparently caused no symptoms or inconvenience.

"Champignon formation" is a term used to denote a granulating and swollen protrusion of the cord through the original skin wound. It is not of the same nature as scirrhous cord, but is due to imprisonment of the divided end of the cord in the wound. The latter may not have been made sufficiently large at the time of operation, or undue traction may have been applied to the testicle or cord with rupture or paralysis of the cremaster muscle as a result.

The actual cause of scirrhous cord is undoubtedly infection, and this may apparently remain latent for years, although moderate swelling may exist without being recognized. We have observed in a mule, considerably over twenty years of age, a suppurating scirrhous cord which appeared quite suddenly. As far as could be ascertained no symptoms had been previously observed, although doubtless some enlargement had existed unsuspected.

The actual organism responsible for scirrhous cord is in all probability botryomyces, though the infection is invariably a mixed one. The common pyogenic organisms are usually present, particularly staphylococci.

The predisposing causes are undue traction upon the cord, too small an incision, faulty technique, particularly as regards asepsis and unusual conditions which predispose to infection. So-called "operating-beds," which are usually composed of dusty germ-laden straw, and certain pastures, frequently carry the causal organisms.

Scirrhous cord more often appears in horses which have been castrated by clam or ligature than in those operated upon by other methods. The old-fashioned iron and clam method appears in practice to be least often followed by this condition.

Treatment.—Internal medication does not yield uniform results. We have observed the apparent disappearance of small growths on the end of the cord, which have been diagnosed many months after castration, following daily administration of two drachms of pot. iodid. In some instances these have become larger and have suppurated after cessation of this treatment, but have again diminished in size upon its resumption. Other cases have not been benefited at all by pot. iodid. even in large doses, nor has any good result followed the injection of fibrolysin and plugging the sinuses with biniodide of mercury ointment. Although in cases where there is extension into the abdomen we are justified in attempting to reduce the enlargement by any of these methods, the only treatment likely to produce a permanent cure is operation, and this should be resorted to whenever the size of the growth does not influence prognosis too unfavourably.

Surgical intervention should, however, be postponed if the enlargement is in a state of active inflammation or is developing a fresh abscess, and should be practised when the growth is as small and inactive as it is likely to become.

The methods practised are mostly similar, excepting that the cord itself may be divided by varying processes as in ordinary castration.

The horse is cast and anæsthetized. Some operators decry the use of chloroform, owing to the amount of hæmorrhage to be expected, but, properly performed, the operation in the average case is not accompanied by serious bleeding. A narrow elliptical piece of skin, in length corresponding with the diameter of the growth, is removed. This, if possible, should include one, at least, of the fistulous openings. Below this will usually be seen a number of varicose veins, especially if the patient be of a fat nature. If these cannot be held aside with ease and safety they should be ligatured and divided. The first two fingers of each hand must then be employed to tear away the connective tissue surrounding the enlargement. A pair of blunt-pointed curved scissors may be used to divide any tissues which are beyond the power of the operator's fingers. By inserting the fingers of each hand side by side, and then forcibly drawing them apart and repeating the process at various parts of the growth, it is quite possible to dissect it out to its origin at the spermatic cord without causing any appreciable loss of blood, whereas if a scalpel be employed to divide the tissues copious hæmorrhage results.

The actual method of division of the cord is a matter for the operator's own judgment.

We prefer to enclose it in an ordinary flat metal castrating clam. Below the clam we apply a ligature of boiled whipcord as tightly as possible whilst we divide the cord above the clam either by the écraseur or the hot iron. The ends of the ligature are left sufficiently long to extend about six inches below the skin wound.

The cavity should then be tightly packed with boiled tow or wool saturated with an antiseptic solution. Eusol, potass. permang., or very weak iodine solution may be employed for this purpose. The skin should be brought into apposition by means of closely-inserted sutures. Forty-eight hours later the plugs may be removed, the cavity irrigated, and a light plug inserted. Probably by this time a considerable degree of swelling of the sheath and scrotum will have ensued, but is of no account. The horse should have walking exercise for half an hour twice or thrice daily from now onwards. The ligature around the cord must be removed about the ninth or tenth day, when it will, in most cases, come away easily, but it may be left longer without danger if it is found difficult to free it at this time.

When the growth extends through the inguinal canal so that its upper extremity lies beyond the reach of the surgeon, the scalpel should be drawn transversely around the highest point of the enlargement which is visible. By thus dividing the thickened tunica vaginalis the mass can often be drawn down the canal and its superior extremity brought within reach. If this be still impossible a large needle carrying a double length of whipcord may be passed through the middle of the highest point of the growth which can be thus pierced, and the corresponding ends of the cords tied as tightly as possible so as to ligature the growth in two separate halves, leaving four ends to hang down outside the skin wound. When the ligation is completed the mass may be divided at least half an inch below the ligatures, and the stump should be seared with a hot iron if it can be brought within easy reach. The portion of the growth below the ligatures will slough off in about a fortnight, if ligation has been efficiently performed, when it may be removed by traction on the ends of the ligatures.

A horse may be thus rendered workable for a considerable time, and in some cases the portion of the enlargement left behind will atrophy and recovery will result with healing of the fistula. As a rule, however, healing is not complete unless the whole of the enlargement has been removed, a small aperture remaining, but this does not greatly inconvenience the animal, neither is it apparent without close examination.

Some operators prefer the écraseur for the removal of these large growths, but as secondary hæmorrhage is of frequent occurrence, and as the density of the tissues or the thickness of the mass often causes the chain to break, its use is open to grave objection. We have seen fatal hæmorrhage ensue five hours after operation by means of this instrument.

Growths of the “ champignon ” type must be removed by opening up the original skin wound and exposing the spermatic cord above the granulating mass. The écraseur may be safely employed in this case to divide the cord.

Occasionally, when operating for a supposed scirrhous cord the enlargement will be found to be composed of a mass of enlarged and frequently suppurating lymphatic glands. No evidence of local infection, as of the skin or penis, can be discovered in most cases, and we must conclude that the infection dates from the time of castration, although frequently years have elapsed.

Removal of the affected glands has always, in our experience, resulted in recovery with healing of the fistula. Sinus formation in the inguinal region may also communicate with an abscess cavity lying between the abdominal muscles. Its situation is usually underlying the external oblique muscle of the abdomen or its tendon, and as the latter forms the posterior wall of the inguinal canal, this is the outlet which affords the least resistance to its exit. A distinct swelling can sometimes be seen midway between the angle of the haunch and the stifle-joint, or just in front of the latter.

The abscess should be laid open at this point, or, if of long standing, its walls will be found to be greatly thickened and it can be dissected out entire. The abscess may sometimes open inside the thigh or just below the inner surface of the patella, instead of through the inguinal canal.

Occasionally a form of botryomycosis may be observed affecting the sheath only. The lesions consist of fibrous thickening with occasional abscess formation. Sometimes a minute sinus persists. Administration of pot. iodid. with local application of an ointment containing iodine 1 part, pot. iodid. 2 parts, lard 8 parts, usually results in recovery.

R. H. S.

DISEASES OF RECTUM AND TAIL

Paralysis of the Rectum

Although by no means a common condition, paralysis of the rectum is occasionally met with as a result of spinal injury, or as a part of a generalized paraplegia. The muscles of the tail are frequently involved, and in some instances the bladder and the retractor penis muscle become paralysed simultaneously. Aged animals appear to be more frequently affected than younger ones, probably on account of senile changes occurring in the lumbar region of the cord and its meninges. In these cases there is frequently chronic dilatation or "ballooning" of the rectum with atony of the walls, and a continual accumulation of fæces.

In a case recently observed in a five-year-old gelding which had fallen down a steep bank, the following symptoms were noticed: from the commencement the retractor penis muscle was paralysed so that the penis constantly protruded from the sheath and hung pendulous. The bladder was partially affected, the urine being expelled in small quantities at a time with apparent effort. The rectum was completely paralysed and was found to be greatly dilated and packed with fæces, which were removed by hand twice daily, otherwise the horse manifested symptoms of colic.

Treatment was mainly expectant, though cold water enemas and nerve stimulants were administered throughout.

The bladder regained its power at the end of ten days, the penis became retracted into its sheath at the same time. The rectum remained paralysed for three weeks, after which recovery was gradual. After two months the horse defæcated in a normal manner.

Whilst cases arising from spinal injury may thus recover, it must not be imagined that prognosis is always favourable.

In aged horses, and when the symptoms form part of a generalized paraplegia, the prognosis is decidedly unfavourable. In paralysis of the rectum dependent upon injury the prognosis must always be guarded, as in many cases it is impossible to diagnose the exact amount of damage done to the cord or its nerves, and fracture occurring in the lumbar region cannot be detected with any degree of certainty.

A form of rectal paralysis is often evident as a symptom of general intestinal paralysis, and is indicated by relaxation of the sphincter ani and failure of the rectal walls to contract upon the hand when inserted. Should peristalsis become re-established in the intestines the rectum again commences to contract.

A similar condition is often seen in cattle after acute diarrhœa, the anus being widely opened and the rectum empty and "ballooned."

In some cases the muscles of the tail become simultaneously affected so that the long hair becomes soiled with urine and fæces. In advancing paralysis the tail is almost constantly affected, whilst the bladder and lumbar muscles become involved generally at a later stage.

Treatment.—This is usually more or less useless, as in cases of paraplegia the administration of medicines is quite futile, whilst in accidental injury to the spine, recovery, when it does occur, is a matter of time.

Emptying the rectum by hand must be practised at least twice a day, whilst some practitioners recommend the use of cold water enemas. Nerve tonics have little effect, though subcutaneous injections of strychnine and *small* doses of arecoline may be beneficial, but the rectum should be emptied by hand previously. In cases of injury to the lumbar region, counter irritation can do no harm, and may be of advantage.

Paralysis of the Tail

In the majority of cases paralysis of the tail either accompanies rectal paralysis or is the forerunner of this affection. At a later stage, general paraplegia, with anæsthesia of the posterior extremities, atrophy of muscles, and paralysis of the bladder, usually sets in.

The condition seems to be due to gradually-developing sclerosis of the cord in the lumbar or sacral region. Dexler observed fatty degeneration of the muscles of the tail, dilatation of the rectum, and changes in the mucous membrane of the bladder. The cauda equina was greatly thickened, and contained masses of connective tissue interposed between the nerve bundles, with partial fatty degeneration of the nerve elements, and constriction of the vessels from pressure. A similar condition was present in the spinal ganglia of the lumbar and sacral regions. (See *Regional Veterinary Surgery and Operative Technique,* A. W. Dollar.)

We have observed cases of unilateral paralysis of the curvator coccygis muscle in two horses which formed part of a stud of hunters. The exciting cause could not be discovered. The tail in each instance as well as being carried to one side was also curved throughout its length. One case recovered in a few days; the other, in spite of all treatment, continued to be carried laterally.

Prognosis in most cases is very unfavourable. Treatment is of no avail. Stimulants, massage, and electricity have all been tried without success. Cases of paraplegia have to be slaughtered eventually.

Tumours of the Tail

Botryomycosis of the tail is sometimes met with, principally in horses which have been recently "docked." Cases, however, not infrequently occur several years after this operation has been performed, and it would almost appear that the organisms responsible lie latent in the tissues for considerable periods. The same remark applies to invasion of the spermatic cord and muscular tissues of the shoulder and other parts, in which lesions often do not occur until some considerable period after the infliction of the wound or other injury which it is surmised has been the point of entry of the organisms.

Various other growths may invade the tissues of the tail. In aged grey horses melanomata are not uncommon, and may appear either upon the sides or at the root of the tail, whereas botryomycomata usually occur at the extremity extending towards the base. Fibromata are not very common at this situation, but are occasionally met with. Carcinomata and sarcomata sometimes occur, more especially in aged animals, but are decidedly rare growths in this region.

Occasionally large vascular tumours appear on the tail, particularly in cattle. They appear to consist of a mass of varicose vessels with a moderate amount of fibrous connective tissue surrounding them.

Treatment.—Tumours occurring at the extremity of the tail are best removed by "docking" as far above the growth as is compatible with a good appearance. When the diseased condition extends to the bone or when malignant growths exist upon the stump of the tail it will be necessary to amputate two joints above the point of origin of the tumour, otherwise healing is subsequently incomplete, and the growth is liable to recur. We once "re-docked" a horse which was affected with carcinoma of the end of the tail upon two separate occasions, but the growth recurred after each operation, and the animal being of little value was subsequently destroyed. Probably had a larger portion of the tail been removed at the first operation the result might have been more satisfactory.

Tumours occurring at the side of the tail or at any point above the stump may be dissected out when docking is out of the question, but malignant growths can only be got rid of by amputation of the tail. Docking close to the root of the tail is an unsatisfactory operation as it leaves a large stump uncovered by hair. The flap operation leaves a far larger area of skin provided with hair roots, which will provide a natural covering of some length, and which will to some extent obviate the unsightly appearance which would otherwise arise from the operation of docking.

The operation is performed as follows: After clipping, shaving, and disinfecting the tail, a tourniquet is applied around its root. Two flaps, one on the dorsal, the other on the ventral surface, are then formed by means of curved incisions meeting on the lateral surfaces of the tail. Whilst these are held apart by an assistant, the tail is amputated by dividing one of the caudal articulations. After releasing the tourniquet the bleeding vessels are picked up with forceps and twisted, or they may be ligatured separately with fine silk. The edges of the flaps are then trimmed to the required shape and length, brought into apposition, and held in position by closely applied interrupted sutures, whilst one or more deep "quilled" sutures are inserted so as to bring the inner surfaces of the flaps into contact, and obliterate any cavity which might otherwise exist between them.

DOCKING
(AMPUTATION OF THE TAIL)

The operation described as "docking" is performed as follows:

The horse must first be placed under proper restraint. If the operation is to be conducted with the animal in the standing position a "trevis" or "stocks" is desirable, but as such conveniences seldom exist outside one's own premises, it is usually sufficient to hold the horse against the side of a stall, the operator standing at the end of the partition and out of reach of the animal's heels. It is very seldom that a horse does strike out during this operation; as a rule his energies are directed towards plunging in a forward direction, but occasionally one meets with a kicker and it is always advisable to allow for such contingency. If a low door exists on the premises the horse may be backed on to this, the tail being lifted over the top. A twitch and a blind should be applied to the horse's head.

The length of tail to remain is a matter of the owner's taste. Mares should be docked sufficiently "long" to hide the vulva, but the stump of the tail must not hang low enough to come into contact with the breeching in harness or cart-horses. The point of amputation having been decided upon, the hair above this spot is turned upwards and secured by a strap or tape, whilst that for one or two inches below it must be closely clipped with scissors.

An assistant now holds the tail in the line of the animal's body, and the operator by palpation discovers the articulation which it is desired to sever. The hollow portion of the handle is slipped under the tail and with one strong movement the blade of the knife is closed, completely dividing the tail.

The stump above the line of amputation is firmly compressed by the encircling fingers and thumb, and a hollow, rounded "docking-iron" at a dull red heat is applied to the divided surface, the hollow of the iron fitting over the bone. After hæmorrhage has been controlled, a pad of cotton wool freely dusted with an antiseptic powder is applied, the strap removed, and the hair brought over the dressing and tied below it with cord, so as to maintain it in position.

To obviate pain the animal may be cast and chloroformed, or the tail may be injected at several points with a 3 per cent solution of cocaine hydrochloride. The vessels may, if desired, be ligatured with silk or sealed by means of a red-hot "budding-iron" without cauterizing the remaining portion of the wound.

In docking puppies a flap incision is made, the most anterior portion corresponding with an articulation. The edges are united by two silk sutures. If hæmorrhage be at all profuse, a piece of tape wound moderately tightly around the tail and removed in five or ten minutes is usually sufficient.

Lambs are docked in a similar manner to horses, but a straight knife is used to amputate the tail, which is subsequently "seared."

R. H. S.

DISEASES OF THE SHEATH AND PENIS

Tumours of the Sheath and Penis

On the external surface of the sheath small warty growths often occur. They may be subcutaneous and sharply defined (fibromata) or irregular in surface and sessile (papillomata). Frequently a considerable number of small black warts occur in clusters on the skin of the prepuce. Carcinoma, melanoma, and sarcoma are occasionally met with in this situation, but are somewhat rare. Enlargement due to botryomyces infection is of more common occurrence, and is in the majority of cases associated with scirrhous cord. The prepuce may be enormously swollen or œdematous from varying causes. Sclerostomes, purpura hæmorrhagica, circulatory or renal disorders, traumatic injury, accumulation of smegma, lack of exercise—any of these conditions may be responsible. We have observed generalized fibrous thickening of the prepuce without evident cause. The parts hung midway to the hocks, were of the size of a football, and apart from their unsightly appearance interfered with progression and micturition. The prepuce was removed by operation, and owing to the adhesions present it was found necessary to remove three inches of the penis also. Recovery was complete in a month, and after the second day micturition became normal.

Tumour formation on the penis itself is by no means rare.

In the horse a growth is often met with, which upon cursory examination appears to be attached to the glans penis. In most cases, however, it will be found to arise from the lining of the prepuce, and has an irregular "cauliflower" surface. It breaks down easily upon palpation and is usually surrounded by a greyish stinking discharge and masses of decomposing smegma. This growth is extremely likely to recur after removal and in a few months may attain its original size. It is liable to interfere with the free passage of urine, induces a condition of phymosis, and causes a considerable amount of discomfort and symptoms often resembling those of mild colic, the animal constantly assuming a position as though attempting to pass urine. These symptoms are aggravated by the presence of quantities of fœtid smegma.

A similar growth sometimes occurs on the penis of the horse, usually near the orifice of the urethra. In addition to interference with micturition it also occasionally gives rise to a considerable degree of hæmorrhage. The penis of the bull is also sometimes affected in a like manner, the growth usually occurring several inches behind the glans.

Carcinoma of the end of the penis is sometimes met with in the horse, particularly when of advanced age.

Early amputation is advisable.

In the dog infective granuloma may give rise to tumour formation on the penis.

Treatment.—Warty growths on the external surface of the sheath may be removed by scissors or the scalpel if of small size, or by means of the écraseur if at all large or if they are provided with a neck. Recurrence is, however, the rule, and it is advisable to dress the parts daily with sulphur iodide rubbed down with lard, removing the scab which forms every day before applying the ointment. Small fibromata may be squeezed out with the fingers after incising the skin.

Papillomata occurring within the sheath must be removed surgically. The horse must be cast, the penis withdrawn and thoroughly cleansed together with the scrotum, and all discharge and smegma removed. The growth is best removed by the wire écraseur, and the resulting wound should be well cauterized with the hot iron to check hæmorrhage and to prevent further growth, an attempt which is, however, seldom successful. Similar growths occurring on the penis must be treated similarly, but when they involve the extremity of the glans close to the urethral opening and are recurrent, amputation of the penis usually becomes necessary sooner or later.

Growths occurring on the penis of the bull are more difficult to remove. The animal is thrown, and as soon as the penis can be protruded, it is secured by a loop of tape and withdrawn from the sheath by steady gentle traction. The growth is removed by means of a scalpel or scissors, and the hæmorrhage controlled by pressure applied by means of a plug of wool soaked in adrenalin solution, or the part may be cauterized with nitrate of silver.

Granuloma of the penis occurring in the dog may be removed with scissors after pouring cocaine solution into the sheath. Hæmorrhage is often severe, and should adrenalin prove inefficient, it may be necessary to put one or two stitches in the mucosa. The parts should be subsequently dressed at intervals with one of the silver proteids or albuminates.

Carcinoma and kindred growths of the penis of the horse necessitate amputation of that organ.

Amputation of the Penis

The chief difficulty to be contended with is the tendency of the divided urethra to close up as the surface of section of the penis heals.

Several methods of operating have been devised by which this obstacle may be overcome, but even with favourable conditions, the operation is not always successful at the first attempt. The fact that the stump of the penis is withdrawn for some distance within the sheath and is completely hidden from view, is distinctly unfavourable to healing, and as the penis must be grappled for and forcibly withdrawn by the hand on each subsequent occasion for purposes of inspection or dressing, considerable difficulty is experienced in maintaining sutures in position.

Whichever method of operation is adopted it is necessary to cast the horse, and for this purpose sidelines are preferable to hobbles. The penis is withdrawn and thoroughly cleansed with warm water and soap together with the surrounding areas. Chloroform must then be administered and a catheter passed and left in position. A length of indiarubber tubing is next tied around the penis well above the seat of amputation, the ends being left sufficiently long to ensure a good hold. This being held by an assistant prevents the organ being withdrawn into the sheath and also acts as a tourniquet. If preferred, a loop of tape may be employed in place of the rubber tubing. There are three methods of operating in general use:

(i.) The penis may be cut through in one stroke, in which case the catheter will not be employed; or the corpora cavernosa may be first divided, after which the urethra is dissected out and severed about a quarter of an inch beyond the stump of the penis. The catheter must then be withdrawn. In either case, the next step is to slit the urethra longitudinally for half an inch along its upper surface. Into the cavity thus produced the point of a conical " budding " iron is introduced at a dull red heat and maintained in position for two or three seconds. A funnel-shaped opening is thus produced which tends to become larger after a few days, by which time the urethra will be found to have become firmly adherent at the lower edges. The tourniquet is then relaxed slightly and the bleeding vessels, of which the dorsal artery is the most important, may be ligatured, subjected to torsion, or sealed by applying the point of a red-hot budding-iron to each.

This method of operating, although somewhat crude and barbarous, has given good results in our hands, and has the further advantage that after-treatment is reduced to a minimum. We have in some cases stitched a short female gum catheter into position and left it *in situ* for the first few days, but it is not absolutely necessary. As a rule soreness prevents the horse from making an effort to stale, and we now adopt the plan of emptying the bladder twice daily for the first few days after operation by pressure of the hand through the rectum. In some cases, however, the horse continues to stale in a normal manner from the time of operation without assistance.

It sometimes happens, when a large growth exists on the penis, that the organ cannot be withdrawn from the sheath. It may then be brought through an incision made in the side of the prepuce which may be sutured after the operation has been completed and the penis replaced.

(ii.) Just behind the intended seat of amputation a triangular piece of skin with the apex pointing backwards is removed from over the urethra. The base of the triangle should be about ¾ inch in width, whilst the length from base to apex should be 1¼ inches. The portion of urethra underlying this area is then carefully dissected free and divided at the lower margin of the wound after removing the catheter. A sharp bistoury is then inserted into the urethra, which is divided longitudinally throughout the entire length of the portion exposed. With a small needle and fine silk the edges of the urethral flap are sutured to the skin along all three sides of the triangle. The stitches must be inserted fairly closely. An elastic ligature is then wound tightly around the penis about ¼ inch below the base of the triangle, and a little below this again the end of the penis is amputated with a scalpel.

The portion below the ligature being cut off from the circulation, sloughs off entire in about ten days. The operation area becomes swollen during this time, usually several of the stitches give way and active granulation takes place. Healing should be complete in two months. After-treatment consists in keeping the parts clean by occasional injection of warm antiseptic solutions into the sheath. The chief guide must be the ability of the horse to micturate. If the bladder become distended and cannot be emptied by pressure per rectum, the penis must be withdrawn and examined, and as a last resort a catheter passed a short distance. Catheters thus employed, either temporarily or left in position, must be provided with a terminal orifice in addition to the usual laterally situated openings.

(iii.) This method aims at more rapid healing; but the result is by no means so certain, as swelling of the penis following operation is liable to tear out the sutures.

The integument covering the dorsal surface of the penis is divided transversely through half its circumference at a point about 1½ inches below the intended line of amputation. This is then raised and dissected free as far back as the latter point. The remaining skin is divided transversely on a level with the base of the flap thus formed. The corpora cavernosa are then cut through at the same level, but the corpus spongiosum is left an inch longer. The urethra is dissected out and hæmorrhage is controlled by torsion or ligature of the vessels.

The flap of skin dissected free from the dorsal surface of the penis is now turned down over the stump. At the level of the urethra an elliptical hole is cut and through this the urethra is passed. The edges of the flap are then sutured to the edges of the skin surrounding the severed stump, whilst the urethra is divided longitudinally on either side and the flaps are sutured to the edges of the elliptical opening.

In the dog amputation may be performed either through or behind the os penis. Reported cases indicate that stricture of the urethra is more common when the operation has been effected by sawing through the bone.

Another method is to apply a ligature immediately behind the os penis and amputate the penis. The skin of the prepuce covering the urethra is then divided longitudinally for ¾ inch, the urethra opened similarly behind the ligature and its edges united by fine sutures to the edges of the skin. An artificial opening is thus established and the danger of stricture occurring is considerably diminished.

Phimosis

This term indicates that condition in which the penis is incapable of being protruded from the sheath. Phimosis is in some instances congenital and due to constriction of the preputial orifice. Thus it is met with in puppies occasionally. In newly-born foals the penis becomes in rare instances folded backwards upon itself, and the young animal is thereby rendered incapable of micturition unless the condition be recognized and remedied. Cases of phimosis occurring in adult life may arise from neglect, injury, or from the presence of new growths either in the sheath or penis.

From neglect, accumulations of smegma become deposited in the folds of the prepuce; from the irritation thus produced swelling of the sheath occurs and inability to protrude the penis results. The urethral fossa then becomes filled with secretions, pressure upon the free end of the urethra results, and the animal experiences great difficulty in passing urine.

Injury to the sheath includes kicks, blows from the whip, and wounds which cause swelling. Œdema of the sheath following castration or arising from purpura, lack of exercise or the presence of sclerostomes in the body, may also produce the condition.

We have observed phimosis following amputation of the penis from adhesion between the stump and the sides of the prepuce. Cicatricial contraction resulted in the drawing in of the sides of the sheath and stricture of the urethra.

New growths occurring on the penis, as carcinomata or large papillomata, may render the organ so large that protrusion becomes impossible. A similar condition of the prepuce produces the same effect. Botryomycosis sometimes extends to the sheath and may greatly restrict the size of the opening.

Treatment.—This must be varied according to the cause of the condition. Inability to protrude the penis in the foal is usually remedied by straightening out the organ with the finger and applying a little vaseline.

The treatment of phimosis arising from neglect obviously lies in thoroughly cleansing the prepuce.

In cases where œdema is excessive, puncture at various points with a needle, followed by exercise, often gives relief.

New growths and enlargements arising from scirrhous cord must be removed surgically.

Congenital phimosis in adults, due to undue smallness of the preputial orifice, may be treated by incising the floor of the sheath and subsequently uniting the upper and lower layers of skin of each side by sutures. Sometimes a V-shaped piece of skin may be removed with advantage or an artificial opening may be made in the floor of the sheath.

Paraphimosis

This term indicates the condition when the penis cannot be retracted into the prepuce. The causes may be too small an opening in the sheath, a swollen penis, or paralysis of that organ.

The preputial orifice may be constricted from the time of birth, as is often the case in puppies and young dogs in which the glans penis protrudes either during defæcation or some other posture or during coition, and is unable to be again withdrawn through the narrow opening. In other cases, when the penis is quite normal in size, the long hairs attached to the end of the prepuce become adherent to the penis during erection, and upon the organ again becoming quiescent these are drawn into the sheath. The skin around the opening then becomes inverted and reduces the size of the opening to such an extent that the glans cannot be retracted. This occurs in the dog, bull, and occasionally in the boar.

The penis, being thus exposed to the air and its venous outflow more or less strangulated, swells and becomes very painful and congested. The glans takes on a dark purple or livid appearance, and after a time droplets of serum exude from it. After a varying period, if relief be not afforded, necrosis may set in. The surface is first affected, and the covering of the penis is rubbed off by friction of the body and bedding, leaving a raw oozing surface beneath. Recovery may, however, ensue even at this stage if the penis can be replaced in the sheath; and experience goes to prove that in the dog the organ may even be exposed for a week without death of the deeper structures, whilst in the horse the condition often lasts for ten or fourteen days with appearances simulating necrosis, and yet complete reduction may ultimately ensue.

In the horse occasionally, but more frequently in the bull, cases are met with in which the penis becomes injured during copulation. The symptoms are swelling and inflammatory changes in the body of the penis a few inches behind the glans. Not infrequently the organ is more or less bent at this point, and it protrudes for some little distance from the sheath. It is a common condition in Jersey and other small breeds, and also in young bulls of any class which are allowed to run with a herd of large cows, and results from repeated unsuccessful attempts at copulation and from striking the penis against the buttocks of the cow.

Paralysis of the penis is a rare condition, but it may occasionally result from local injury, from sclerosis of the lumbar portion of the cord, or in conjunction with paraplegia.

Paraphimosis is also associated with certain diseases, as purpura, influenza (rarely), but not infrequently occurs as a sequel to castration in the horse.

Prognosis.—This is favourable in cases where true paralysis does not exist. Loss of power traceable to the retractor penis usually terminates in injury to the organ from blows from the patient's hind feet or from contact with the ground whilst the animal is lying, and amputation is usually necessary.

Injuries resulting from copulation usually recover with proper attention, although bulls thus affected are sometimes incapable of serving afterwards. In some cases the end of the penis is no longer capable of erection.

Paraphimosis in the horse is often very persistent, but the majority of cases recover eventually. It is unwise to perform amputation until all sensation has disappeared and the penis is cold to the touch. A fortnight is often required to effect reduction.

Treatment.—In dogs pressure upon the swollen glans usually brings about diminution of its size, when the prepuce can be straightened out and drawn over it. Should this be impossible, the lower edge of the prepuce may be nicked with a bistoury, when reposition will be greatly facilitated.

Injury occurring during copulation in the bull may be treated by frequent warm fomentations and the application of lead liniment. Any attempt at replacing the glans is futile whilst the swelling exists in the body of the penis. Recovery usually occurs in from five days to a fortnight.

Paralysis of the penis may be treated by massage and stimulating liniments applied to the skin between the anus and scrotum, hypodermic injections of strychnine, and by the use of a triangular suspensory bandage with which to sling the penis. Paraphimosis following castration or occurring as a complication of influenza or purpura is relieved by local scarification, and in some cases by slinging, though this is not advisable in purpura, as sloughing may occur. Astringent lotions, such as lead and alum lotion, may be beneficial, whilst in some cases cold swabs are of assistance.

When the prepuce is chronically thickened or indurated a form of paraphimosis may persist in which the glans assumes the shape and size of a turnip. Circulation is, however, but little interfered with, whilst micturition is normal. The prepuce may be removed after applying a series of ligatures overlapping each other right around its circumference. It is seldom necessary to amputate the penis, as this soon assumes normal proportions after removal of the prepuce. R. H. S.

TYMPANITES OF THE RUMEN

Synonyms.—**Hoven, Bloating, Gaseous Indigestion, Tympanitic Indigestion, Dew-blown, Fog-Sickness, etc.**

Definition.—Distension of the rumen by gases formed as a result of fermentation of the contents of the organ.

General Remarks.—Cases of tympanites may be looked upon as acute when the rumen is greatly distended and there is danger of suffocation, subacute when the swelling is easily compressible and there is little evidence of uneasiness, and chronic when the tympanitic condition persists for several weeks.

It may be either primary or secondary. Acute primary tympanites is almost invariably the result of acute indigestion set up by a gross dietetic error capable of upsetting apparently healthy animals, though the condition may be contributed to by an existing atonic state of the rumen walls. But though the latter may not be present as a predisposition it is soon produced by undue or prolonged inflation of the organ. The hoven that accompanies choking is a marked exception to the rule that acute tympany is primary in character and the result of indigestion. But secondary forms of tympanites are seldom acute in character. Tympany of the rumen is perhaps the most common symptom of digestive disorders met with in cattle. All cases are more or less serious, the acute forms because of the imminent danger of suffocation, and the less acute or more chronic types because of the prolonged displacement of abdominal and thoracic organs to which they give rise, and the greater difficulty that is experienced in divining and removing the cause that has set up the condition. The displacing effect of marked tympany is a grave matter in animals advanced in pregnancy, in cases of hernia, or when old abscesses exist in connection with thoracic or abdominal organs or old adhesions confining quantities of peritoneal exudate which are liable to rupture under excessive strain. A certain amount of gas is normally present in the rumen of healthy animals, and is generated while the food is undergoing treatment in the organ, but the amount is limited, being governed by the eructations of it that occur during feeding and rumination, and when the animal is at rest. That considerable quantities of gas are so released is confirmed by the fact that obstruction of the gullet which prevents eructation immediately leads to gaseous distension of the rumen. But, within limits, the gas present in the rumen of healthy animals varies in quantity with the diet, and consists chiefly of carbonic acid, sulphuretted hydrogen, carburetted hydrogen, and a little nitrogen and oxygen swallowed from the atmosphere. The nature of the gases present in cases of tympany likewise depends on the quality of the food that is undergoing fermentation, but in most cases carbonic acid is in excess, and with it is a variable quantity of marsh gas, carbon monoxide, hydrogen sulphide, oxygen, and nitrogen.

Tympanites.—This dangerous condition is usually a sudden development due to an easily determined cause, but less acute forms occasionally assume an acute character after a time and under certain conditions. Two varieties of tympanites are met with which differ according as the gas is free to be tapped or otherwise, viz. :

(*a*) Cases in which the gas lies in bulk on the top of the ingesta, and is capable of quick extraction by trocar and cannula ; and

(*b*) Cases wherein the fermented gas exists in agitated and intimate mixture with the entire contents of the organ, akin to a boiling or effervescent mass in a cauldron, so that only a little bubbling of gas follows the use of the trocar, and little or no relief is afforded.

Causes.—Obstruction of the gullet, as in cases of choking caused by a piece of turnip, mangold, or potato, etc. Here, as already stated, the gas is free to tap. Scarcely less sudden in their development are those cases of the second form caused by an immediate change of diet to luxuriant clover, wet with dew, and colloquially referred to as cases of dew-blown or fog-sickness. Many such cases occur every season when, through want of caution, the animals are put for the first time on the clover crop when its flowering heads are very wet.

If the animals are very hungry they very soon fill their paunch with the quickly grown, cold, wet, and succulent herbage, and without having to exercise their limbs very much. The quickly swallowed mass of food to which they have not been accustomed chills and renders anæmic and passive the walls of the rumen so that the organ fails to perform its functions and rapid fermentation ensues. Danger is most pronounced if there has been frost in the early morning and the temperature of the bedewed herbage is very low—when wet with rain only the crop is not quite so dangerous. Besides the red and white clovers, which are specially indicted because of the water-carrying capacity of their large flowering heads, the other leguminous plants, peas, vetches, beans, tares, etc., when consumed in a wet condition, are more apt than ordinary grasses to produce gaseous indigestion, since they are more susceptible to fermentation. It is in a less degree, therefore, that tympany is liable to follow on a sudden transition from winter food or from poor to abundant pastures, but susceptible animals are victimized if put out in the early morning when the grass is covered with hoar frost. In fact it is at all times risky to put animals too suddenly on green food of any kind to which they have not been accustomed for a time. Fermenting, half-withered grass which has been cut and left in a heap is readily eaten by many cattle, often with bad results. The consumption of frozen roots or cabbage, etc., in quantity is often followed by tympany—their chilling effect leading to enervation of the rumen. Potatoes are unsafe if given in too great quantity, and the use of a small ration of diseased potatoes has frequently been disastrous, Other foodstuffs demanding caution in their use include bean straw, turnip tops, and any kind of food that has begun to ferment. Many plants or shrubs, *e.g.* meadow saffron, hemlock, deadly nightshade, ranunculus, rhododendron, yew, etc., which are more or less poisonous are readily eaten by cattle, and set up hoven, but this in great measure occurs as a sequel to the inflammation caused by their irritant action on the digestive mucosa. Again, any factor capable of shocking the system, paralysing digestion, and interfering with the act of rumination may lead to tympany, *e.g.* chill from prolonged exposure to storms or biting winds, violent exercise after feeding, drinking of large quantities of ice-cold water, etc. Foreign bodies in the rumen and reticulum act in a similar way, *e.g.* balls of hair or wool, pieces of wood, leather or bone, wires, needles, nails, or fœtal membranes which have been swallowed, etc. But while food liable to speedy fermentation because of its quality and condition must be considered the chief factor in producing acute gaseous indigestion, it must be borne in mind that susceptible animals, and especially such as are predisposed by an atonic state of the digestive organs, from whatever cause arising, are more readily victimized than their healthy neighbours, and in them, even, minor dietetic errors lead to hoven.

Symptoms.—The appearance of the objective signs of acute tympany is in many cases a speedily progressive matter, and if the animal be on wet clover it may continue to feed until signs of discomfort or actual pain are evident. The upper left side of the abdomen becomes ballooned, the measurement of its circumference being vastly increased. The swelling is at first softly, but soon becomes tensely, elastic and resonant like a drum, and the freer the gas the more drum-like is the sound produced by percussion. On the other hand the rumen, distended with solid or semi-fluid food only, presents its chief swelling lower down than the upper left flank if unassociated with tympany. If the ear, placed over the tympanitic paunch, detects no crepitation sounds but only occasional rumbling noises, we may conclude that the gas present is free to tap as in cases of choking, and not in intimate mixture with the food. But if active crepitation sounds are heard they betoken the existence in the stomach of a bubbling effervescent mass, and the practitioner need not expect to give much relief by any small puncture of the rumen. When the tympanitic state is sufficiently advanced the patient becomes uneasy, respiration is accelerated, laboured, and shallow, and as the pain increases the animal moves backward and forward, stamps and kicks at the abdomen, crouches and endeavours to lie down, but if it goes off its feet in a vain effort to seek relief from pain it is soon up again because of the difficulty experienced in continuing respiration. The tail is lashed about, the back is arched, and at irregular intervals semi-fluid excreta and quantities of urine are voided. After a time the dejecta may contain mucus or blood. The animal champs the jaws and salivates or gapes with the tongue hanging out. It grunts and moans with abrupt sounds, the action of the heart is violent and palpitating, and the pulse frequent, small, and later on almost imperceptible. The circulation is evidently greatly disturbed by the forward pressure of the swollen organ, there is engorgement of the superficial veins of the neck, and the visible mucous membranes are deeply congested or cyanosed. The nose is poked out, and in some cases gases are belched up or actual vomiting may occur. Such symptoms according to their degree are salutary, but they are not very common, and to yield marked relief they require frequent repetition. As the case advances the swelling becomes as high as the spine, the eyes are bloodshot and protruding, and the suffocating animal staggers on its feet and falls asphyxiated. If the victim of acute tympany be relieved by operation or otherwise, untoward sequelæ may present themselves in the course of a day or two as a result of the pressure exerted and the excitement caused by the distended paunch, *e.g.* pregnant animals may abort, peritonitis may arise as a result of the bursting of an existing abscess, or the rending of old adhesions, or the passage of a foreign body into the chest may be precipitated, setting up a traumatism of the heart, lungs, or pleuræ. Some difference of opinion exists as to the immediate cause of death, but, while it may be conceded that some neurotic animals die suddenly as if from nervous shock or cardiac interference, we entertain no doubt, and the cyanotic condition of the majority of cases before death is proof, that death results from carbonic-acid poisoning. Absorption of the deleterious gases contained in the rumen, which consist chiefly of carbonic acid, proceeds during the progress of the case, and the poisoned state of the blood is soon augmented and rendered insupportable by the gradual failure of respiration. Death occurs in some cases of acute hoven within half an hour if the animals are not relieved by suitable treatment. When the fermentation is less active the animals live for an hour or two before suffocation occurs, but the period of time that elapses is controlled in some degree by the presence or absence of eructations of gas from the paunch.

Diagnosis.—The condition is easily recognized by the presence of a quickly-developed, resonant swelling in the superior aspect of the left flank. As already stated, the swelling seen in impaction of the rumen with food only is lower down and non-resonant. The diagnosis of the cause is also an easy matter in most cases of acute hoven, though this cannot be said of the less acute or chronic forms.

Prognosis.—Acute tympany is always serious, but much depends on promptitude in treatment. If several cases occur simultaneously in a clover field the practitioner must act quickly and adopt heroic measures if the lives of the animals are to be saved. If marked eructation of gas is established the patient may gradually recover without being operated on. The recovery of some animals that have been punctured is more or less protracted owing to the occurrence of untoward sequelæ. In all cases the value of the animals is considerably reduced.

Prevention.—All conditions known to set up tympany are to be avoided. The common causes of choking, which is always accompanied by tympanites, are well known and are to a great extent capable of elimination. The dangerous cases met with in fields of clover emphasize the need for certain precautions in utilizing this useful aftermath crop. To begin with, the animals should not be put out on growing clover when they are hungry, or in the early morning when it is cold and soaked with dew, and they should be kept under observation during the short hour that they are allowed on the crop for the first day or two. The risk is greatly minimized if they are fed before being put out, and this should be done preferably in the afternoon or at least when the herbage is quite dry. After these preliminary precautions the animals get accustomed to the change of diet and are soon able to consume the crop even on a wet day without bad result, though it can never be considered safe to allow them on growing clover in the early morning when it is soaked with moisture or covered with hoar-frost. The use of frozen roots or cabbages is to be avoided, as their consumption in quantity sets up indigestion that is often accompanied by tympanites. When frozen they should be kept in the byre for twelve hours before being offered to the herd. Roots that have become decomposed owing to bad storage are capable of upsetting digestion and causing acute hoven in some animals; nevertheless, it is remarkable that most cattle readily eat, and with impunity, large quantities of the repulsive-looking, soft, and evil-smelling turnips that are to be seen on many farms in the early springtime. This great wastage would not arise if all roots were stored in a dry condition in suitable weather, and the pits or heaps properly covered to prevent the penetration of frost. Owing to the evil effects of drinking quantities of very cold water by housed animals the temperature of the water so used should be raised, in frosty weather, by the addition of a reasonable amount of warm water. If the cattle be turned out to water at a pond or running stream they drink less greedily than in the cow-shed, and the exercise they get lessens the risk of danger. The prunings of yew trees and other poisonous shrubs should be burned, and if dangerous trees or shrubs are within reach of grazing animals they should be suitably fenced off. The larger animals often fall victims when the fence is too low and the smaller ones escape. At all times when a radical change of food is intended, and especially from indoor rations to green food of any kind, this should be made gradually, giving at first only a small amount and daily increasing the proportion of the new diet. If cut green food is to be used it should be secured when dry and kept dry, and given to the cattle while it is still fresh. Animals suffering from febrile complaints which prejudice digestion and cause suspension of rumination cannot safely be fed on food-stuffs liable to ferment in the rumen, and should receive only easily-digested food such as bran and linseed mashes, pulped or boiled roots, cooked gruels, and a little good hay. And because acute tympany is often so quickly fatal that death may occur before professional assistance can be got, cattle-owners should possess, and know how to use in an emergency, a suitable trocar and cannula for puncturing the swollen paunch, as well as a sharp knife for enlarging the opening if necessary. The practitioner when he does arrive can very often make good the recovery of an animal with an ugly gaping hole in its flank by means of which the amateur managed to relieve the suffocating patient.

Post-mortem Lesions.—The carcase is enormously rotund even at first, but soon becomes more so unless the gastric contents force an exit by the gullet and nostrils. Rupture of the rumen is only occasionally seen, but the lesion is usually a post-mortem one. Rupture of the diaphragm may be present and it sometimes occurs prior to death. Rupture of the right auricle of the heart has also been recorded. The abdominal organs are usually pale and more or less bloodless owing to the pressure that has been put upon them, but hæmorrhages are sometimes to be seen. The walls of old adhesions that enclosed pockets of peritoneal exudate are often burst and their contents scattered. The capillaries of the skin and remote organs are engorged, the usual appearances set up by death from asphyxiation are present as well as ecchymosis, and it may be extravasations on the chief serous membranes. In females advanced in pregnancy there is often evidence that the uterine contents have suffered. The condition of the ingesta in the rumen varies in different cases.

Treatment.—When tympany has just set in, the patient should be forcibly exercised and the swelling should be rubbed and kneaded with both hands to try and establish eructation from the stomach. This may also be assisted by placing a piece of wood or an ordinary wooden gag in and athwart the mouth, secured on each side by a strap or piece of rope to the horn. This should be done at once, too, in all cases of choking if a probang is not at hand or if its use has proved ineffectual and likely to be dangerous if persisted in, and before resorting to puncture of the rumen. Cold water ablutions are also recommended as a stimulus to the belching up of gas. There are not many cases of acute primary tympanites in which the passage of the hollow probang taps successfully the imprisoned gas, nevertheless it should be tried if the state of the patient permits, for though it fails to take off the gas its use is sometimes followed by eructations that afford some relief. Sometimes actual and salutary vomition occurs when the tube is withdrawn, and this in some cases has been so forcible that death has occurred from drowning, some of the uncontrolled and barmy semi-fluid ingesta having found its way into the trachea. In other cases broncho-pneumonia has been set up by strayed material, in too small quantity to cause sudden death by drowning. When the animal is restless and nervous the passage of the probang is not an easy matter, but it should be done with as little disturbance to the animal as possible. While an assistant steadies the head by the horns and so elevates the mouth, the practitioner separates the jaws with one hand and with the other passes the oil-smeared probang as speedily as possible down the gullet. If gas emerges freely through the tube, the latter should be kept in position until the swelling has gone down. Thereafter, in order to prevent further fermentation and collection of gas in the rumen, stimulants and chemical antidotes, as recommended in the treatment of chronic tympany, should be administered. If necessary the tube may be passed a second time, when it is again likely to afford relief. But if only a little bubbling of gas and fluid takes place through the tube when it is in position, the indication is that the ingesta is in a barmy condition and that even the use of the trocar and cannula will be ineffectual. In all urgent cases that have defied the above measures, and before resorting to rumenotomy, as well as in cases of choking by an awkward and dangerous obstruction, relief must be tried by puncture of the rumen. Sometimes the instant use of the trocar is called for as soon as the animal is seen. The puncture should be made at the height of the swelling at a point on the left side at equal distances from the last rib, the transverse process of the vertebræ, and the point of the haunch-bone. The operator stands on the left side of the animal with his back to its head, and with the right hand plunges the instrument into the stomach and withdraws the trocar. The instrument should be from 6 to 7 inches long, oval in shape, and about ⅝ inch broad. If gas emerges freely, steady pressure should be exerted on the cannula, especially if it be a short one, for the emptying stomach regains its tone and, beginning to squirm, tilts the cannula to such an extent that they may lose connection and render necessary a second puncture of the stomach wall. Stock-owners who summon courage to puncture the swollen stomach usually operate with any pointed knife that is at hand, and very often the hole made is too small to act efficiently, and it occasionally happens that some of the gas finds its way into the meshes of the loose tissue between the "fell and the flesh," producing an extensive subcutaneous emphysema that persists for many days. When a simple puncture of the rumen does not succeed and the case is urgent, rumenotomy must be performed. (See p. 1025.)

Chronic Tympanites.—In chronic tympany the swollen state of the paunch is more or less persistent. It may be permanent or intermittent. When intermittent it is usually most pronounced shortly after the animal has swallowed its meal ration, and in some cases the swelling begins to subside when the patients have begun to eat hay or straw, the deglutition of the balls of roughly-masticated food seeming to favour the upward escape of accumulated gas.

Causes.—Many cases of chronic hoven are secondary in character, being dependent on remote causes. Others are primary and due to existing disorder or disease of the organs of digestion. On the other hand, subacute cases are intermediate in character between acute and chronic, are commonly the result of faults in dieting, etc., and are more amenable to treatment, their etiology being more easy to decide. To determine the cause of chronic tympany is often a difficult matter, since it is so often a condition secondary to chronic disease of other important organs and structures, *e.g.* the liver, peritoneum, uterus, etc. It is commonly seen in tubercular animals and in badly-nourished pregnant cows. Acute and subacute cases if improperly treated readily acquire a chronic character owing to the atony of the stomach walls which results when recovery is protracted. Moreover, oft-repeated fermentation gives rise to catarrh of the gastric mucosa, and this perpetuates gaseous indigestion. Tympany is therefore a common accompaniment of rumenitis, reticulitis, due to foreign bodies, and gastritis, caused by improper food or poisonous leaves or twigs, or chemical poisons, or the over-use of purgative medicines, and it is often present in cases of peritonitis and ascites. Many of the most persistent cases are dependent on conditions that cause partial stenosis of the gullet, inhibiting the physiological eructations of gas from the stomach, *e.g.* enlarged mediastinal glands, suprasternal abscesses caused by the passage of foreign bodies from the reticulum, enlargement of the liver due to abscess formation or invasion by multilocular cysts of echinococci, etc., any of which may exercise pressure on the œsophagus. Again, foreign bodies of large size in the rumen prejudice its functions, and if situated near to the œsophageal groove interfere with eructation. Accumulation of sand in the stomach is also a potent cause, and arises when animals are fed on meals that are impure through admixture with sand derived from the grinding of dirty cereals. The heavy material loads the stomach and paralyses its motor power. The latter also arises when an animal is enfeebled from such causes as lack of or abstinence from food, improper food, exhaustion, wasting diseases, septicæmia of uterine origin, etc., and tympany soon appears when the functions of the rumen are badly performed or cease altogether. In young animals hair-balls in the rumen cause tympany.

Symptoms.—The hoven condition of the stomach in chronic is less severe than in acute cases, and the other signs of disturbance are correspondingly less marked. The swelling is at first intermittent to some extent and may be almost absent for a period before each meal. It is usually aggravated after feeding, and eventually, if the cause is not removed, the swelling persists though its tenseness is subject to variation. Palpation shows that in all cases the gas is free to tap. Rumination is irregular or suppressed, and it is only when the swelling falls a little that any attempt is made to chew the cud. Appetite is irregular, sometimes depraved, and often in abeyance, the bowels are lazy and the dejecta glazed, but diarrhœa may be seen during a period of increased hoven. Respiration is thoracic and shallow, and a grunt of oppression is occasionally heard. Loss of condition is fairly rapid, especially if fever or diarrhœa be present. Tympanites in cattle is never relieved by the passage of flatus per rectum.

Diagnosis.—This presents no difficulty, and only a novice could mistake chronic tympany for impaction of the rumen or dropsy of the abdomen or uterus. As in acute cases, the swelling is marked on the left side and situated high up where the flank is normally hollow, it is resilient to pressure, percussion gives a drum-like sound and yields no wave movement such as that seen when a dropsical abdomen is sharply struck. The swelling seen in hernia of the rumen is too low down to be mistaken for tympanites.

Prognosis is always grave.

Post-mortem Lesions.—Increased capacity of the rumen is evident though the ingesta may be under normal in bulk. The lining membrane is in a catarrhal state and lesions may be present in the bowels, the carcase is anæmic and often greatly emaciated, and there is little fat to be seen. When the case has been due to some diseased condition involving the gullet, this is usually very apparent in the shape of enlarged glands, a tumour or abscess, etc.

Treatment.—During the treatment of chronic tympanites the food allowed should be easy of digestion—bran mashes, boiled roots, demulcent drinks, and a little good hay or straw. If the case is well established before advice is sought, great care should be exercised to determine the cause, if possible, and treatment should be directed towards its removal, and even when this is deemed practicable, it must be remembered that the lost tone is not easily restored to an organ that has been subjected to continued distension. If there be evidence of generalized tuberculosis or persistent stenosis of the gullet, the animal should be slaughtered. Medicinal treatment in suitable cases is most likely to be successful in the early stages, but as the most potent drugs for the dissipation of tympany render the flesh unfit for food, medicinal measures should only be attempted when it is not intended, at any stage, to salve the carcase. The agents likely to prove useful comprise antiseptics, stimulants, and purgatives, and perhaps gas absorbents. Sodium hyposulphite in 2-ounce doses dissolved in a pint of water may be given two or three times a day, or sodium bicarbonate in similar doses. A favourite drench is 2 ounces of oil of turpentine in a pint of raw linseed oil with 15 to 20 minims of oil of peppermint, and this may be given once or twice on the first day, subsequent doses of turpentine being given once a day in milk instead of oil. Formalin in doses of two drachms well diluted with cold water may be given twice a day. Dilute hydrochloric acid is useful combined with bitters and nerve stimulants, such as gentian and nux vomica, to stimulate the mucous, salivary, and alkaline secretions and control fermentation. Chinosol, creolin, lysol, izal, and kerol are also worthy of trial. But no treatment is likely to be of permanent value that does not include the use of moderate saline purgatives, such as the sulphate of soda or magnesia or common salt, in doses of a half to one pound according to the size of the animal. The purgative dose should be combined with ginger and some treacle, and followed by 1-ounce doses of carbonate of ammonia given in a quart of cold water at intervals of four hours for three times. When mild purgation has been set up, the animal may be put on the hydrochloric acid, gentian, and nux vomica mixture or the following :

℞ Pulv. pot. nit. ʒij.
Pulv. nuc. vom. ʒij.
Pulv. zingib. ʒiv.
Pulv. gentian. ʒiv.

M. ft. pulv. Sig. One to be given twice daily in a bottle of ale or gruel.

If drenching is to be avoided the following electuary is a useful substitute :

℞ Sod. chlor. ℥j.
Pulv. nuc. vom.
Pulv. zingib. } āā ʒj.
Pulv. gentian.
Theriac. q.s.

M. ft. Electuar. Sig. The whole to be smeared on back of tongue twice or thrice daily.

The electuary should be made up in bulk of several doses. When animals are dangerous to drench, easy purgation may be induced by placing in the mouth with a wooden spatula a mixture of common salt and treacle of proper consistence and, taking advantage of the thirst induced, to give repeated 4-ounce doses of salt in drinking water, the doses to be reduced or withheld according to results. Large doses of tincture of ginger have been highly recommended, and these may with advantage be continued with tincture of nux vomica and dilute hydrochloric acid. Electricity applied over the gastric region is advised by some authors, as well as the use of eserine, veratrine, apomorphine, tartar emetic, and barium chloride. A sinapism over the region of the stomach is of distinct service in some cases. But the adoption of mechanical means to get rid of the gas must not be too long delayed or the walls of the viscus will lose tone to a serious degree. The swelling should be vigorously rubbed and forcibly palpated, and, if eructation of gas is not thus set up, the probang should be passed, and if successful this may be repeated as often as necessary. Puncture of the rumen secures the desired result at once in chronic tympany, and the cannula should be left in position for two or three days, during which time suitable medicinal treatment is carried out. After the removal of the instrument the orifice is soon sealed up, but if the digestive functions are not restored the tympany returns, the animal sickens anew, and the trocar has to be used again. The cannula is liable to dislodgement, and if too often reinserted a localized peritonitis is set up and the likelihood of a satisfactory recovery is remote. In such cases, instead of repeated use of the trocar and cannula, a modified rumenotomy should be performed to provide an effective means of escape for all gases of fermentation and afford an opportunity for the manual exploration of the interior of the stomach, the removal of foreign bodies that may be present, and the breaking up and removal, if necessary, of masses of agglutinated indigestible food.

RUMENOTOMY

This operation, also known as gastrotomy or paunching, is sometimes performed for exploratory purposes in obscure cases of ruminal, reticular, or omasal indigestion, for the removal of foreign bodies, sand, or poisonous material that the animal is known to have swallowed, for the partial unloading of the paunch in cases of impaction with food before the animal is unduly exhausted, and a modification of the operation is of marked value in a certain type of acute and in some cases of chronic tympanites.

(1) *Complete rumenotomy*, which includes the suturing of the wounds made, is likely to be successful in those cases in which it is possible to avoid or remove such contamination of the serous surfaces and the wound in the abdominal wall as would interfere with healing and in which the operation is not likely to be followed by the occurrence of tympany. The animal should be secured by the neck in a stall, with its right side to the wall. The hair is then shaved from the operation site in the flank. An assistant should hold a horn in the right hand and the nose in the left hand, using, if necessary, bull-dog nose-pincers. To restrain and steady the animal effectively he should stand with his back against its neck, pressing it against the wall and flexing it on his body by pulling the nose to the left. The tail should be tied to the right thigh if it is not used to steady the patient against the wall posteriorly. The operator then inserts a sharp-pointed bistoury through the abdominal wall into the stomach at the usual seat of " puncture of the rumen," and, cutting outwards and downwards in a slightly forward direction through all the structures simultaneously, he makes a wound from 3½ to 6 inches long. If only an exploration of the stomach for foreign bodies or other obscure causes of digestive trouble is intended and the rumen is not distended, the lips of the stomach wound will not bulge through the outer gap, and the examination of the interior may be done as soon as a piece of jaconet or other suitable material steeped in antiseptic solution has been placed over the lower edges of the wound to prevent soiling and protect the peritoneum. But, should the extraction of more than a little bulky food be necessary, involving repeated insertion of the hand and arm into the stomach, several temporary stitches should be put through the abdominal and gastric walls, binding them together during the emptying process, and two of them may be made to include and secure in position the protecting antiseptic cloth. This prevents displacement of the stomach during unloading and escape of fluid into the peritoneal cavity. Before closing the wounds the condition of the œsophageal canal, the reticulum, and the omasum should be examined. The temporary stitches and protecting cloth are now removed, the edges of the wounds and the adjacent serous surfaces

are cleansed with an antiseptic solution, and the stomach opening is closed with sutures of strong catgut so placed that the mucosa will be inverted and the serous surfaces brought firmly together. Thereafter the external wound is recleansed with the antiseptic solution and closed with interrupted sutures of strong silk cord or catgut. Perfect healing should result if due care is exercised to prevent sepsis. For several days after the operation the patient should be restricted in diet to small rations of cooked food, gruels, bran mashes, boiled roots, etc.

(2) *Incomplete Rumenotomy.*—Up to a certain point this operation is essentially the same as that already described, but the binding sutures are not removed and the wound is left to heal at leisure. It is an operation that can be strongly advised in cases where a complete rumenotomy would be likely to fail from sepsis or in which a patent aperture is an advantage for a period to enable excess of gas to escape which, if the wound were closed, would accumulate with disastrous results, forcing us to reopen the stomach or use the trocar and cannula. This modified rumenotomy should be adopted more often in chronic tympanites, since it not only provides a venue for more accurate etiological diagnosis and, it may be, the removal of the actual causal factor, but also affords for some weeks absolute immunity from further tympany and its attendant distress and depression. In animals that are subject to chronic indigestion, but especially in milch cows, it is the tympany that chiefly matters so far as their immediate utility in milk-production is concerned, and when its occurrence is provided against by an operation that is not followed by peritonitis the animals do very well and often recover entirely. On the other hand, the repeated use of the trocar and cannula, which implies periods of hoven and depression, usually begets a painful localized peritonitis that hastens the undoing of the animal. But the operation is of the most signal service in these cases of acute tympanites wherein the barmy, semi-fluid ingesta bursts out so soon as the stomach is opened. In some cases, and according to the consistence of the material, two or three pailfuls may be voided in a forcible stream with no other assistance than manual retraction of the lips of the wound, the fingers being in contact with the mucosa of the stomach. Until the escaping food has ceased to flow spontaneously, there is no danger of any part of it finding its way into the peritoneal cavity, as the viscus is still in close contact with the wall of the abdomen. At this point, not less than six stitches of strong cord should be inserted joining the stomach wall to the abdomen, and as the in-contact serous surfaces are unsoiled there is speedy and healthy union. The needle should be washed and disinfected before the insertion of each stitch. Thereafter the further emptying of the stomach can be carried out until only two or three pailfuls remain. This is accomplished by exerting upward pressure on the abdomen by means of a sheet or sack placed below it and by using a long iron spoon or spatula for the removal of masses that may block the opening. Active fermentation of the remaining ingesta soon ceases; the side of the animal is then washed and the wound cleansed and disinfected. The patient is afterwards placed in a stall with its left side to the wall and warmly clothed, though only a thin sheet should cover the wound. The edges of the wound are subject to soiling if the animal coughs, and should be cleansed and disinfected every day. It usually heals up in five or six weeks, leaving a hollow, puckered scar. The stomach is now permanently fixed to the abdominal wall, but this does not seem to prejudice its functions materially. After-treatment includes putting the animal on easily-digested food for a few days, the administration of a mild purge if necessary, and afterwards stimulants, nerve tonics, and stomachics. The medicaments may be poured directly through the opening into the rumen. It is our experience that much value is lost annually in bovine animals because owners are afraid, or hesitate until it is too late, to open the rumen. They should be instructed how to act in an emergency, and the opening, however roughly made, should be large enough in cases occurring in a clover field to admit the escape of the frothy ingesta. The after-treatment of the cases can then be carried out successfully by the practitioner when he arrives.

H. B.

DISEASES OF THE MAMMARY GLANDS

Animals that suckle their young are known as mammalia. They are provided with special organs or glands called mammæ (collectively known as the udder, the milk-vessel, or milk-bag) which secrete the milk intended for the support of the young animal for some time after birth. They differ in size, contour, and situation with the species, and their number varies from one to five or six pairs. Mammals possessing several pairs have them arranged in a row on either side of the inferior median line of the body, beginning near the posterior aspect of the abdomen and stretching well over the chest. The number of pairs is closely related to the number of young brought forth—from one pair in the mare to five or six pairs in the sow. The mammæ are present in both sexes, and are rudimentary in early life, but while no material change takes place in them in the male, they become developed with age in the female, undergoing special enlargement during gestation until they attain their maximum size immediately after parturition. As the close of the suckling period approaches, they diminish in size through the collapse of the gland tubules, and eventually return almost to their original dimensions, though it is usually possible to tell by the appearance of the glands and teats whether an animal has been suckled.

Anatomical Construction of the Mammæ.—This is essentially the same in all mammals. The skin which covers and protects the mammæ is soft and fine, and in supporting the tissue proper of the gland it is assisted by a subcutaneous covering of thin elastic tissue which sends processes into the glandular elements or parenchyma, forming partitions between the chief lobes. Fatty tissue is present more or less, according to the condition of the animal, between the glands and the skin. Each gland has a separate envelope of elastic tissue which enables it to undergo considerable enlargement in volume without injury, and so long as the envelope is uninjured it prevents communication between the mammæ.

Imperfections of the elastic envelope are often demonstrated during the inflation of the udder when treating cows for milk-fever. The glandular tissue or parenchyma is arranged like a bunch of grapes. The chief lobes are made up of smaller lobules composed of the milk-secreting cells and minute ducts. When drops of milk form in the milk-cells or acini they gravitate into the small connecting milk-ducts, which, by union with others, form the milk-duct for each lobe. Eventually the numerous milk-ducts coalesce and, converging to the centre of the gland, form the galactophorous or milk-sinuses to which the secretion is carried. From the milk-sinuses proceed the excretory or teat canals, which run parallel in a straight course to the free extremity of the teat, where they emerge, each orifice being provided with a sphincter composed of circular bundles of muscular and elastic connective tissue which involuntarily prevents the escape of the milk and is only rendered patent by pressure from above or suction. The teats are the organs by means of which the young suck the milk from the milk-sinuses above. They are covered with skin devoid of hair and have, at their base, numerous small glands that secrete sebaceous matter which protects the delicate integument of the teats.

Mammæ of the Cow.—The cow's udder is situated in the inguinal region and consists of two halves—a right and a left—lying side by side and easily separable. Each half is subdivided into an anterior and a posterior gland, so that the udder consists of four separable glands or quarters. The anatomical divisions between the front and back quarters are not so well defined as that dividing the two halves of the organ. The teats vary in length and bulk, being too small in some families of Ayrshires, while in some shorthorn and cross-bred cows they are unduly large, indicating extension of the milk-sinus almost to the extremity of the teat. Two small supernumerary teats are occasionally met with on the posterior aspect of the gland. They are often imperforate and have no superimposed gland tissue. But in some cases gland-tissue does exist, and the teats are more developed and yield a few drops of milk. In rare instances this part is the seat of induration, and the extent of the gland-tissue present is indicated by a flat, bun-like swelling in which the teat is centrally placed. The circular muscular fibres, round the orifice of the teat, which form the valve or sphincter at the point of the teat, are well developed in the cow. The "blood supply" to the udder is carried by the two mammary arteries, each of which penetrates its own side of the organ on its upper surface and, dividing into two, sends one branch to the anterior and one to the posterior quarter. A deep set of veins accompanies the mammary arteries, while others, which collect the blood superficially, unite to form the large sub-abdominal or milk veins. The degree of development of the milk veins is held by many to be an index of a cow's milk-producing capacity. The udder has a well-developed system of lymphatic vessels, all of which empty into the supramammary glands, two in number, one on either side, situated near the perineum, in a cavity above the posterior quarter of the organ and outside of its elastic envelope. The nerve supply is from the two mammary nerves—anterior and posterior—but little is known regarding their disposition and endings.

Mammæ of the Mare.—These are two in number, placed side by side in the same part of the inguinal region that the scrotum occupies in the male. When active, each gland is hemispherical in shape and is separated from its fellow by a shallow fissure. Ligaments of fibro-elastic tissue connect and support them to the abdominal wall. The skin is soft and black, and is covered by fine hairs which disappear towards the teats. The teats are conical in shape and are pierced by two or more orifices, which give exit to the milk from the two or more milk-sinuses situated above and whose cavities freely communicate with each other.

Mammæ of the Goat and Ewe.—These animals have only two mammæ and they are situated in the inguinal region. Though somewhat similar in shape in both animals and having well-developed conical teats with a single canal, the glands and teats of the goat are greater in volume than those of the ewe, and the teats point slightly forward.

Mammæ of the Bitch.—The bitch has usually ten mammæ, arranged longitudinally in two rows, one on each side of the median line; two of them are pectoral, two abdominal, and one inguinal. The milk-sinuses are absent or ill-developed and the truncated teats have several orifices.

The **Cat** has two pectoral and two abdominal mammæ on each side.

Mammæ of the Sow.—The sow has ten or twelve mammæ, arranged as in the bitch. Each gland is circumscribed by a depression, the teats are not well developed, and they have several orifices.

Secretion of Milk.—As the age of puberty approaches considerable development of the mammæ occurs, causing increase of volume through the bifurcation of ducts and additions to their minute structure. As gestation advances the enlargement of the gland is progressive, vascularity is increased, and the milk vesicles become bigger and more numerous. These actual changes in the glands cause considerable swelling in their substance and œdema of the surrounding tissues, and shortly before parturition the secretion of milk commences. When the young animal is born the cavities in the glands become fully distended. The first milk is called the "colostrum," which is an alkaline, light yellow fluid of creamy consistence, and rich in proteid. The colostrum is intended as, and serves the purpose of, a purgative which effectively clears the meconium out of the intestinal canal of the newly-born animal. The volume of the glands is maintained during the active period of lactation, and when the secretion of milk lessens and eventually ceases, the glands return almost to their normal size.

Anomalies of Function.—Many writers have put on record instances of virgin animals showing evidence of mammary activity by some increase in the size of the mammæ and the secretion of milk for a time. In human medicine it has occasionally been observed that some milk is present in the breasts of newly-born infants; similarly in equine medicine many observers have noted mammary activity in newly-born fillies. Smith, of Beccles,[1] saw a foal one day old whose mammæ were swollen and hard. After rubbing the gland one pint of milk was drawn off. The glands remained active for ten to twelve days and on the ninth day œstrum occurred in the foal as well as in the mother. Pettifer,[2] of Tedbury, records that a shire filly was born with fully-developed mammæ and teats one inch long. Each gland yielded half a pint of milk, which was microscopically the same as that secreted by its mother. We know of no recorded case in which lactation has been seen in the newly-born of any other species. Many cases are on record, however, in which animals that never were mated have shown mammary activity and acted as foster-mothers. Neurotic virgin bitches, kept as pets and not allowed to bear young, sometimes acquire the habit of licking the parts, beget lactation, and lick up the exuding milk. We know of such a case in a Scotch terrier bitch, four years old, whose bed is constantly wet and noisome. This phenomenon, when it does occur, is usually seen twice a year in bitches. The records of many cases of this kind show that such animals have often usurped the place of the actual mother and successfully reared her progeny. Still more common is it to meet with cases where animals that have been mated and failed to conceive have exhibited some degree of function in the mammæ, and secreted milk at the time when parturition would have been due if they had fallen pregnant. This anomaly in every species is encouraged if the mammæ be manipulated or the teats suckled by a young animal. When it is desired to treat this condition the patient should be purged and put on short rations. She should be isolated from other animals, old and young, and the mammæ and teats should be painted over daily or oftener with a nauseous and bitter liquid, such as a strong solution of aloes.

Agalactia.—Agalactia or absence of milk in the udder is occasionally met with in cows and mares after parturition, and may be temporary or permanent. Often met with after abortion, it is also occasionally seen after normal pregnancy, especially in mares that have only been bred from late in life or that have not been pregnant for a number of preceding years. In such it is sometimes due to physiological disturbance in the function of the mammæ that is difficult to account for, and then the glands are small, and there is an absence of the usual plumpness and tenderness on manipulation. But more often defective secretion of milk is the result of previous disease or of existing chronic disease of the udder itself, or is due to grave pathological conditions of important organs associated with debility, anæmia, and emaciation. It is common after difficult parturition when the animal remains exhausted and feverish for a number of days, and if recovery is protracted the function of the udder may fail to be established until the end of a subsequent pregnancy. In grossly mismanaged dairy herds agalactic conditions may be very prevalent. In such a case where our advice was sought at a time when a dozen cows were recently calved, we found the animals so ill nourished and weak from insufficient and improper food that they were almost "dry" when they should have been in full flow. Failure to secrete milk may be due to atrophy or wasting of the substance of the mammæ, the result of former disease, and it sometimes occurs in cows with a great appearance in whose enormously large and indurated udders it would seem that the function if not the entire structure of the milk-secreting cells had been destroyed by the undue pressure to which they were subjected by the unyielding and over-developed intercellular tissue of the organs.

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[1] Smith, *Veterinary Record*, vol. xiv. p. 148.

[2] Pettifer, *Veterinary Record*, vol. xx. p 18.

Treatment.—Success depends altogether on the cause of the defect. If the mammæ seem healthy and are only faulty in size and activity they should be massaged twice or thrice daily with a little spirit and olive-oil. The diet should be changed to sloppy, nourishing, cooked food, including draff; warm milk may also be allowed, and in this way many temporary cases are quickly overcome. If functional activity is delayed, recourse may be had to drugs that have the reputation of stimulating the milk-secreting cells, *e.g.* fennel, caraway, aniseed, juniper, and sulphur. These should be mixed in equal quantities and two tablespoonfuls of the mixture given once or twice a day in food or administered in a pint of stout.

Anomalies of Development.—*Absence of the mammæ* (*amastia*) is exceedingly rare and only found in association with grave developmental defects, *e.g.* in complete hermaphroditism. M. Sanson mentions the case of a cow and Lafour one of a mare that suffered from the defect.

Absence of the teats (*microthelia*) is also rare.[1] Joachim da Costa, Veterinary Hospital, Khairpur State, Sind, reports the case of a four-year-old cow that had no teats but only four round coloured spots showing the seat of the nipples. No openings were apparent, but below each spot could be felt a finger-like process. He made incisions over each spot, exposing the processes, and removed the milk by a teat-tube. He does not state whether the exposed processes were capable of being milked by hand or suckled thereafter.

Imperforate Teats (Congenital).—An imperforate state of the teat is occasionally seen in animals whose mammæ and teats seem normal in appearance, and the fault, usually confined to one teat, is only discerned when a first attempt is made to milk the animal. (Acquired stenosis of the teat canal, the result of accident or disease, is more common. (See p. 1034.) Here we are only concerned with the defect as it is seen in primiparæ.) It may be located at the point of the teat or near to the top of the teat canal, or the teat canal may be entirely obliterated.

Symptoms and Diagnosis.—The diagnosis is easy, for, when an attempt is made to milk the teat, not a drop can be drawn off, and if the cow is suckling her calf the owner's attention is attracted by the swollen state of the quarter. When the fault is at the point, the teat is ballooned and an examination reveals the absence of an orifice. If the imperforation is located at the top of the teat it is, in most cases, due to the presence of a delicate membrane which prevents the entrance of the milk into the teat canal, and in this case as well as in complete obliteration of the teat canal, the teat is undistended and feels more or less solid.

Prognosis.—The outlook is hopeful unless in cases of obliteration of the canal of the teat.

Treatment.—When there is no orifice and the teat is filled with milk it should be grasped with the left hand so as to distend the canal to its extremity, which should then be pierced by a small sterile trocar held in the right hand, and when this is withdrawn a sterile milk-tube is inserted and the milk drawn off. Thereafter the teat is steeped in a weak solution of an antiseptic in a cup and, after drying, an aseptic bougie is put in position to keep the orifice patent. This is repeated after each milking until the perforation wound has healed and a permanent orifice has resulted. When a partition of membrane is present higher up in the teat, it is usually capable of being pierced by an upward thrust of a pointed silver teat-tube, through which the milk immediately flows. There is little danger of wounding the mammary tissue by this procedure, as the milk-sinus above is distended with secretion, and it is desirable to make some lateral movement with the metal tube to enlarge the puncture and break down the delicate curtain. The teat may then be suckled or milked by hand, and there is usually no untoward result if aseptic precautions are taken. When the teat canal is completely obliterated nothing should be done, and if there be no interference the congestion and swelling of the gland soon subside and complete atrophy or wasting results.

Injuries of the Mammæ.—These are roughly divisible under two heads: bruises and wounds. Both types of injury are common in all domestic animals that spend a large part of their time in the open, and the danger is greatest to those that have largely-developed and pendulous mammæ. In herbivora the quality of the field hedges or fencing and the nature of the ground surface are factors that often predispose to injuries of the udder.

Bruises or Contusions.—The udders of the cow, goat, and ewe are much subject to bruises on account of their great development and the risks attached to unrestrained grazing in the company of many neighbours. The posterior pair of mammæ in bitches and sows that have bred several litters often hang so low that they are liable to and on occasion are the seat of bruising. When subjected to blows of any kind the mammæ are more apt to suffer contusion when fully distended and firm, so that they offer a comparatively unyielding impact to the stroke or blow. By butting with the head, the sucking calf may bruise the udder of its mother. More frequent causes are contact with blunt stakes when jumping fences, blows from the horns of other animals, kicks, etc. We have occasionally seen the udder of a paralysed, prone cow bruised by a tramp from its neighbour, when insufficient care was taken in turning the latter out to water. Bruising of the udder is occasionally met with in dairy cows on board ship during stormy weather, and animals subjected to railway journeys are often the victims of treads on teats and udders.

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[1] Da Costa, *Veterinary Record*, vol. xvii. p. 517.

Symptoms.—There may be only a slight discoloration of the skin and a little local swelling, or there may be considerable exudation of blood subcutaneously, and if the blow has been very severe the mammary tissue may be injured, when blood extravasation penetrates more or less deeply into the gland. In such cases the secretion from the quarter may be mixed with blood for several days, and there is considerable pain and swelling. Sometimes a subcutaneous clot of blood is formed without any marked disintegration of the glandular tissue as indicated by the absence of discoloration of milk from the quarter. An Ayrshire cow, not in full milk, failed to negotiate a hedge and the front of her left fore quarter came into contact with a square-edged post. Seen immediately afterwards, her udder showed only a linear excoriation five inches long, but very soon a round tumour, eight inches in diameter, appeared, indicating subcutaneous hæmorrhage.

Sequelæ.—When the bruise is severe and is followed by painful swelling and deep discoloration, a slough may separate after some days. Injury to the gland-tissue is often followed by inflammation which tends to end in abscess formation. Mastitis occurs all the more readily if the skin is broken and precautions have not been taken to prevent the entrance of bacteria, or when, in the absence of a lesion to the integument, the acini have been injured and so rendered incapable of resisting the attack of udder-contained organisms, hitherto held in check, that so often exist in the mammæ of cows belonging to a herd in which cases of mammitis are of common occurrence.

Treatment.—Slight contusions need no treatment. In more severe cases the part should be cleansed with an antiseptic solution, dried, and then thickly smeared with a layer of lukewarm cataplasma kaolin and glycerine, covered with a layer of cotton-wool, and if necessary a suspensory bandage should be applied. This should be renewed every twelve hours till pain subsides, when the part may be gently massaged with a mild stimulating liniment. The teat of the affected quarter should be drawn four times a day or oftener if the milk is in any way altered.

Wounds.—Animals possessed of pendulous udders—the cow, goat, and ewe—are most commonly the subjects of lesions in this region. Cows that have the habit of jumping fences are specially liable, and forcible contact with large thorns, sharp stakes, taut and barbed wires produces a variety of lesions from scratches to deep penetrating or lacerated wounds that sometimes involve the teat to the escape of milk, or it may be almost torn off and need amputation. When the horns of animals given to goring their neighbours are unduly pointed or sharpened through contact with the wall, they are capable of producing ugly excoriation of the integument and actual piercing of the udder tissue. Other causes include improper bedding containing sharp substances, bites from dogs, etc., and wounds are sometimes caused maliciously or otherwise by utensils used in the cow-shed. Wounds involving the teat canal or the milk-sinus, allowing the escape of milk, seldom heal satisfactorily and a fistula often results. All wounds of the udder are serious, especially when the organ is functionally active, because of their liability to become soiled through contact with dirty floors or bedding. Deep punctured wounds are often followed by gangrene more or less extensive. In a case of this kind, a penetrating wound caused by a horn-gore, little attention was given to the cow's injury, and gangrene resulted. After the dead portion was thrown off the cow was in good health, but the lesion left presented an unusual appearance, compared to that seen when a slough has separated in cases of non-traumatic gangrenous mammitis. Instead of the usual granulating wound, there hung from the lesion from eight to ten red bleeding stumps—some of them branched—varying in length from three to ten inches, and in diameter from ⅜ of an inch to one inch. When operating on the stumps by ligature and excision it was seen that a healthy blood-vessel formed the nucleus of each, and was clothed by rapidly-growing granulation tissue or proud flesh, which had bled freely through contact with the inner aspect of the hock. It was evident that the less resistant tissues of the part had become dead and sloughed off before complete involution of its nutrient vessels had taken place.

Treatment.—It is in most cases bad practice to stitch up wounds of the udder, especially the part from which milk escapes. The wound should be cleansed with weak antiseptic solutions, loose shreds of tissue should be clipped off, and after drying with a clean cloth the surface of the lesion may be painted with carbolized glycerine (1 in 16) or a solution of iodine, or dusted over with boric acid to which a little iodoform may be added. No bedding should be allowed, and the floor under the udder should be scrupulously cleansed and disinfected as often as necessary.

Milk Fistulæ.—When a teat is injured during lactation and the teat canal or milk-sinus is exposed, the constant escape of milk interferes with complete healing and a fistula results. In dry animals, with careful treatment, such wounds often heal perfectly. Fistula of a hind teat is occasionally seen in primiparæ. The history usually is that when the young calf was examined the teat was seen to be branched or had a small supernumerary teat attached near its base, which the owner had snipped off with a pair of scissors after deciding to rear the animal. Fistulæ originating from this cause are invariably encircled by more or less firm tissue —the base of the amputated appendage. When a deep-rooted wart on the teat is removed by the common practice of plucking it off with the fingers, the resulting wound may ulcerate and penetrate to the teat canal. Milk fistulæ are usually located somewhere in the teat, but the opening is sometimes in the udder near to the base of the teat. If the aperture is large, the milk is continually trickling away, soiling the floor and making it noisome. When smaller, there may be very little escape of milk for six or eight hours after each milking, but when the teat is drawn two streams of milk proceed from it and it is usually impossible to direct both into the milk-pail. The slightest handling of the udder usually starts the flow of milk from a fistula, or when the dripping is constant, increases it. A fistulous teat constitutes unsoundness in a dairy cow. It is a serious defect, not only because it is a nuisance and causes material loss of milk, but because it is a permanent predisposition to mammitis through the teat being continually wet with secretion. The wet teat has every opportunity to become soiled when the cow lies down, bacteria grow readily on the film of milk, and it may be presumed that the ordinary fistula is a less effective bar to bacterial invasion of the udder than the normal orifice at the point of the teat.

Treatment.—No surgical measures need be attempted during lactation, because the secretion and unavoidable discharge of milk make healing impossible. Operation may be tried when the cow is quite dry and is likely to remain so for a few months. The animal is cast and a perpendicular incision is made over the fistula, exposing the teat canal. The hardened or cicatricial tissue of the fistula is curetted away, and after drying the wound one or two deep silk sutures are inserted closing the mucous membrane of the canal, and thereafter the skin wound is closed by four or five stitches. The part should then be painted over several times with flexible collodion and an aseptic bougie of some length inserted into the canal. The animal's bed should be kept scrupulously clean, and, if necessary, a new bougie is inserted after two days. Unfortunately, these operations are not always successful, especially in the case of old fistulæ. If an operation is inadvisable, cows with a lacteal fistula should be put on grass to foster one or two calves and then be fattened for slaughter.

Teat Sores.—The integument of the teats is liable to mechanical injury, but the great majority of cases of "sore teats" are of the nature of chaps and fissures or cracks. All young animals and thin-skinned cows are especially liable to these conditions. Sore teats are very troublesome, as they render the animal fidgety and difficult to milk, and if suckling a calf the attentions of the latter are resented.

Causes.—In newly-calved queys and fine-skinned animals the delicate integument of the teats is liable to break and become fissured through failing to support the friction of hand-milking or suckling, and doubtless the milk or mixture of milk and saliva usually left on the teats has a macerating effect on the cells of the epidermis. Cows, when suckling calves affected with "thrush of the mouth," are often the victims of teat sores. The skin of the teat is at first tender, and if not carefully looked after, the alternate distension of it before, and relaxation after, milking soon cause cracks to appear. When left wet with milk, etc., the wrinkled parts of the empty teat present a soapy appearance through shedding of superficial cells that have undergone maceration and been cast off. One or more sores in the form of cracks may result in this way, and they readily extend in depth and length under the irritation of the milking process. The season of the year influences the production of sore teats. The condition is most common and troublesome during the wet periods of spring and autumn when there is slight frost during the night, and when many cows are calving and the animals are at grass.

Symptoms.—Before the formation of a fissure the skin of the part about to break is red and tender, and the lesion is often made during milking, the hand of the milker being a little blood-stained. A superficial crack gives little pain, but when it deepens and widens under the necessary manipulation of milking, infection of the wound is common and the teat becomes inflamed, tumefied with inflammatory exudate, hot, and very painful. When in this condition it is a difficult matter to get the cow milked by hand or suckled. If the point of the teat is involved the gravity of the case is much increased, the orifice becomes sealed with coagulated discharge that needs removal before the secretion can be drawn off, and not infrequently, owing to incomplete removal of the contents of the quarter and extension of infection up the teat canal, an acute attack of mammitis supervenes and septicæmic sequelæ often follow.

Prognosis.—This is favourable if the point of the teat remains healthy. But in some cases, even in the absence of implication of the sphincter, the teat becomes so infiltrated with inflammatory swelling that proper milking is impossible, and, by a process of extension into the prejudiced mammary tissue, the quarter becomes " weeded."

Treatment.—Preventive measures embrace cleanliness, keeping the animal comfortable and free from draughts, drying the teats after milking and smearing them with a little glycerine, lard, or a mixture of lard and beeswax, lanoline, or lead liniment. These measures are most essential in primiparæ and fine-skinned animals at the commencement of lactation. When cracks have formed, the affected teats, after milking, should be steeped in a cupful of a weak solution of Jeyes' fluid, lysol, or other antiseptic, and then dried with a clean cloth or absorbent cotton-wool. Thereafter, the parts should be smeared with one of the following dressings:

℞ Liq. plumbi subacet. fortis ℥ij.
Glycerin or ol. olivæ ℥xvi.
M. ft. lin.

or

℞ Ac. carb. ℥i.
Glycerin Oj.
M. ft. lin.

or dry dressings may be used, dusting the parts with boric acid or a combination of boric acid and iodoform. Zinc ointment, to which a few drops of carbolic acid have been added, serves well for superficial sores. Indolent sores should be lightly touched with nitrate of silver, and healing of deep fissures is hastened by the use of wet dressings. A suitable piece of plain or boric lint is steeped in water that has previously been boiled, and after applying it to the teat it is covered by a piece of jaconet or other waterproof material held in position by two light rubber bands. If it be evident, notwithstanding the use of suitable dressings, that healing is not making headway because of the want of rest to the parts caused by milking, the use of a teat syphon becomes imperative, provided the milk shows no change in its character. This procedure gives rest to the lesions, and they heal readily under proper care.

Observations on the Use of Teat Syphons.—The best tubes are made of silver. They vary in diameter and should be selected to suit the capacity of the teat sphincter. Tubes that are too thin fall out, and when their diameter is too great their insertion injures the sphincter, which must at all costs be avoided. The tube selected should be sterilized by boiling on every occasion before use. As a further precaution the teat and tube may be steeped in a weak antiseptic solution. The syphon is then introduced into the teat canal, carefully avoiding contact of the instrument with teat lesions, and when milk has ceased to flow the quarter is manipulated before withdrawing the tube. The tube is then washed in clean cold water, dipped in lysol, and laid past wrapped in lint. When wanted again it is only necessary to pass it through boiling water. In our experience it is disastrous to use a syphon when the sphincter has been injured, as it is then almost impossible to avoid carrying infection into the teat canal and setting up catarrh, nor is it good practice to attempt emptying of the quarter by syphon where the character of the secretion has changed and is no longer uniformly liquid.

Teat Eruptions.—In certain specific diseases, cow-pox, foot-and-mouth disease, malignant catarrh, and rinderpest, the skin of the udder and teats is the seat of well-marked eruption, and in the case of cow-pox the eruption is confined to the mammary gland. Other eruptive conditions of the teat are met with which in some respects simulate those of variola, and have been grouped under the name of varicella or false cow-pox. We have also met with endemics of " sore teats " of streptococcic origin in which the lesions were constant in character and differed materially from those seen in variola and varicella. The eruption of "cow-pox" (*variola vaccinia*), which for the purpose of differential diagnosis may be taken as our standard, is divisible into four stages.

(1) *The papular* or *nodular stage* is characterized by the presence on the teats and skin of the udder of little firm red nodules, giving the teats a " shotty " feeling. The nodules increase in size and arrive at

(2) *The Vesicular Stage.*—The vesicles are formed by the exudation of lymph; the smaller ones coalesce to some extent, forming larger vesicles comprised of several lymph-containing compartments. The head of the vesicle is pale yellow and depressed or umbilicated, and this is thought to be due to the binding effect of the unmacerated borders of the primary vesicles that have grouped together. The lymph in the vesicles, of which there may be from two to six on each teat, soon changes and the eruption assumes the

(3) *Pustular Stage.*—The vesicle has now

become a pustule, greyish in colour, the contents being turbid and purulent. The centre of the pustule is more or less rounded, having lost the pitted appearance of the vesicular stage, and around it there is a red zone of congestion (hyperæmia). The pustules gradually dry and reach

(4) *The siccative stage*, when crusts are formed under which the regeneration of tissue gradually takes place. The crust is then thrown off and, if the papillary layer has been involved, a slightly depressed scar is left. It is not often that the eruption passes through these regular stages on the teats, for the vesicles are often broken by the hands of the milker, secondary infection occurs, and the sores assume a hæmorrhagic type often associated with much infiltration and tumefaction of the teat. It is also by the hands of the milkers that infection is carried to other cows, and not uncommonly the milkers become inoculated themselves and are incapacitated for a few days by sore hands and sickness.

Differential Diagnosis of Specific Teat Eruptions.—The vesicles met with on the teats in foot-and-mouth disease, instead of being multilocular and pitted as in cow-pox, have a single cavity with no central depression. Again, in cow-pox there is an absence of the marked constitutional disturbance, the characteristic lesions of the mouth and feet, and the rapid spread of disease to non-milking members of the herd and to oxen, pigs, sheep, etc., so typical of foot-and-mouth disease. In rinderpest an eruption is occasionally seen on the udder and teats which does not closely resemble that of cow-pox, while the highly infectious, febrile, and fatal nature of the disease readily serves to distinguish the two affections. Again, in malignant catarrh there is no difficulty. The teat eruption is lenticular in character, so that it cannot be mistaken for cow-pox, while the early appearance of gross mouth lesions, accompanied by high fever and grave signs of ill-health in malignant catarrh, are in marked contrast to the almost imperceptible symptoms of constitutional disturbance in most cases of cow-pox. In eruptions due to *streptococcal infection* pustules are directly formed which vary in size, and some of them end in small abscesses which ripen and burst, leaving ulcerating sores. In varicella or false cow-pox the eruption more closely resembles variola. The vesicles are, however, directly formed, there being no papular or "shotty" stage; they are small and rounded, or flat, but never umbilicated. It is rarely that any of them become pustules, the rule being that the small vesicles simply dry up and throw off a thin crust like a broad flake of bran, leaving no scar. In October 1909, eruptive disease of the teat closely resembling varicella occurred in a herd of seventy milch cows near to a large town, and our advice was sought because the medical officer of health threatened to stop the milk supply. Every cow in the herd became infected, the eruption passed through its course in seven days, except in a few cows in which it became irregular (which was doubtless the result of teat stripping causing bursting of the vesicles and allowing secondary infection), the cows maintained their health, and there was no appreciable drop in their yield of milk. Microscopical examination of the contents of a freshly-opened vesicle revealed diplococci, which readily grew in pure culture when sown on artificial media. The medical officer's apprehension of danger was based on the fact that, coincident with this outbreak, an epidemic of septic sore throat occurred in many of the houses receiving the suspected milk supply, and it was also asserted that diplococci were constantly recovered from the throats of human patients. However, an examination of the cows in five other dairies distributing milk in the same quarter disclosed that several of the animals in three of these herds were showing the identical eruption present in the herd whose milk they proposed to ban. Fortunately, no case of sore throat occurred among the milkers nor in the family of the owner, all of whom consumed the raw milk every day, and we pleaded successfully that the human infection was more likely to be due to the prevailing bad weather—which was cold, wet, and stormy—than to bovine infection, since, at the time, throat affections were quite common in many other districts.

Precautionary Measures for Eruptive Diseases of the Teats.—Milkers should wear clean garments, wash and disinfect their hands before going on duty, and as often as is necessary during milking. The udder and teats of every cow should be swabbed with a cloth wet with antiseptic solution and then dried. Similar swabbing and drying of the udder should take place after milking, and the teats of thin-skinned and newly-calved cows, especially heifers, should be smeared with some bland emollient dressing. When eruptive disease does appear, isolate the affected, and detail for them a special milker, who should not approach the healthy animals, since the spread of the disease is mainly by the hands of the milkers. If it is not possible to house the affected animals separately or to supply for them a special attendant, they should at least be moved to one end of the byre and be milked last, the affected teats receiving suitable treatment. Infective eruptions often originate with the introduction into the herd of young cows commencing lactation, so they should be housed separately for some time.

Abnormal Conditions of the Interior of the Teat—*Relaxed Sphincter.*—Cases are occasionally met with in cows with apparently normal mammæ in which the sphincters of the teats—usually the hind ones—are so incompetent that milk begins to escape (lactorrhœa) before the cavities of the glands are fully distended with secretion. This incompetence may be due to weakness dependent on insufficient development of the circular elastic and muscular fibres of the sphincter or to an over-patent state of the orifice itself. In either case there is an absence of proper resistance to the pressure exerted by the milk when it collects in the milk-sinus, considerable loss of secretion results, and this creates a nuisance on the floor of the stall. Cows defective in this respect are "free" to milk, the secretion flowing in a thick stream from the teat, and for economical and sanitary reasons it is obvious that they should be emptied more frequently than is usual with normal animals. If detailed to suckle young, a cow that drips milk should have two calves to ensure the complete use of her secretion. If she has only one sucker, and is a heavy milker, the attention given by the young animal to one teat is accompanied by much escape of milk from one or more of the other teats. In other cases it may be necessary to supplement the function of the weak sphincter by applying a circular rubber band to the point of the teat, by blocking the orifice with a sterile bougie, or, in less needful cases, by painting collodion over the orifice. Relaxation of the sphincter is frequently seen in prize-bred milch cows and is often due to the repeated overstocking that is practised to put them in full bloom for exhibition. It constitutes at all times a predisposition to mammitis.

Constriction of the Sphincter.—This condition is more common than its antithesis (relaxation of the sphincter), and there are few large commercial herds that do not include one or two cows that are "stiff to milk" owing to a contracted state of the sphincter and smallness of the orifices of the teats. It is usually met with in long-teated, cross-bred animals whose teats when the hour for milking arrives are distended with secretion down to the point, and it would seem that in such cases unusual development and competence of the mechanism responsible for the retention of the milk existed by special design on the part of nature. Constriction of the sphincter is easily diagnosed, for even a strong milker has considerable difficulty in withdrawing the milk, which issues in a thin thread-like stream. Unfortunately, the condition often gets worse, for the extreme pressure which it is necessary to exert on the teat during milking has the sinister effect of hardening the valve and the atresia becomes more complete.

Treatment.—Surgical measures used to be commonly practised, but in our hands they have proved worse than useless. They consisted in dividing the sphincter with a single- or double-edged instrument—the "bistouri caché." The immediate result was always good, but when the small wounds made had healed the defect was usually more pronounced than before. Beneficial results are obtained only by the use of bougies for the possible dilatation of the orifice, care being taken not to bruise the inner lining. Bougies for this purpose should be light, and the best ones are made of aluminium or hollow silver, like a tapering blind teat-tube, or of bone. A piece of coloured thread should be attached to the end of the bougie that protrudes from the teat when it is to be left in position for some time, as it sometimes falls out. The coloured thread facilitates its recovery from the bedding, and after being sterilized it is again fit for use if its surface is smooth and uninjured. In some cases a suitable set of milk catheters is made use of to save the difficulty of hand-milking, but their constant use requires the exercise of great care and antiseptic precautions.

Adventitious Growths in the Interior of the Teat.—These vary in size, shape, and position, and the relative obstruction occasioned by them may be partial or complete. Their character and position can be judged by palpating the teat and introducing a teat-tube as a sound. Sometimes the obstruction consists of a warty-like growth or granulation attached to one side of the sinus, while in other cases there is a pronounced circle of thickened mucous membrane which readily develops further under the irritative effect of milking into a complete diaphragm beyond which no milk can pass. In certain families possessed of narrow, supple teats, this insidious circle of thickening develops during the first lactation period, and when it exists in one teat traces of commencing growth are usually discernible in some of the other teats.

Symptoms.—When the obstruction is only partial, milk can be drawn off slowly in a thin stream, but the milking of the teat becomes progressively more difficult until complete obstruction takes place, the seat of obstruction marking the limit of distension of the teat by the accumulated secretion. In the absence of surgical interference and bacterial infection the pent-up secretion distends the sinus to its utmost capacity, the quarter becomes congested, tense, swollen, and painful to pressure, but very soon secretion is suspended, the contents of the gland become absorbed, and the quarter shrinks into a state of functional inactivity.

Treatment.—In our experience it is courting disaster to adopt surgical measures of any kind for the relief of partial or complete obstruction due to the presence of adventitious growths on the teat lining that have appeared during the lactation period. When the milk can no longer be drawn off by hand it should be allowed to accumulate and produce the desirable results referred to above. The most careful use of sounds, grooved needles, quills, catgut, milking-needles, etc., for dilating the canal can only give relief by causing lesions, and the almost invariable result is an acute attack of mammitis. Similar remarks apply to the use of even specially designed instruments by means of which warty granulations can be cut away. If the case be left to nature while the milk is still unaltered, the cow, though the quarter is lost, suffers little in health, whereas after the most careful surgical interference there is a certain risk of mammitis and possibly gangrene.

Obstruction by Calculus.—Lacteal calculi, composed of lime salts and casein, occasionally form in the milk-sinus and cause intermittent obstruction. They can be distinguished from granulation outgrowths by their extensive freedom of movement under palpation. If small, it may be possible to evacuate the calculus by manipulation, while larger ones may be capable of being broken down by pressure exerted on them through the teat and removed with the milk without causing material injury to the mucous membrane. If this is not practicable, extraction by incision is the only resort.

Inflammation of the Skin of the Udder in the Region of the Groin.—A scalded condition of the skin of the udder in this region is more common than is generally supposed, and calls for remark. The udder integument is thinner and more delicate here than elsewhere, especially in cows, amply protected as it is from injury by the great width of the thighs. The cases of dermatitis in this location which we have seen have been almost confined to animals recently calved, whose mammæ were so large as to compel a straddling pose and gait in order to avoid painful compression of the organ between the thighs. Mild cases often escape notice entirely, and, owing to failure on the part of owners to examine the groins of cows whose immense udders impinge on the inner aspect of the thighs over a large area, it often happens that in one or both groins the entire surface of contact has become acutely inflamed and weeping, emitting a putrid odour and presenting in the deep cleft between the organ and the leg the appearance of a huge traumatism.

Causes.—The chief "predisposing" factor is the highly-congested and enlarged state of the udder at the period of parturition, while the intimate contact of the thighs prevents lateral expansion of the organ and totally inhibits ventilation of air. Moreover, in some recently-calved cows the œdema that accompanies the hyperæmic condition of the gland at this period is such that when the leg is abducted the impress of the thigh is seen to be deeply marked on its broadside. "Exciting" factors comprise eruptions on the skin of the udder, soiling of the parts with genital discharges, mud, or grit, and excessive exercise causing undue chafing of the opposed surfaces.

Symptoms.—The animal is disinclined to move and walks with a straddling gait. At rest she stands with hind feet as wide apart as possible, and, failing to rid herself of discomfort when standing, she is often recumbent. But the state of the groin is seldom recognized until betrayed by the odour and presence of blood-coloured discharge on the udder and thigh beyond their border of contact.

Treatment. (*a*) *Preventive.*—Cows about to calve or newly-calved should have limited exercise only. To prevent groin mischief and other more serious results they should be taken to and from marts in suitable cattle-floats. The groin of every straddling cow should be carefully and repeatedly examined, especially after traversing muddy roads, and the region should be washed with soap and water, dried, and dressed with an emollient. The tail and hind parts of the cow should be disinfected daily.

(*b*) *Curative.*—Keep the cow in the stall on a well-bedded floor. Empty the udder four or five times a day, to reduce if possible the contact of the abraded surfaces. Bathe and cleanse the parts twice a day with warm water containing a little bicarbonate of soda, dry with a soft clean cloth, and apply oxide of zinc ointment or lead liniment, or dust the parts well with either boric acid and starch (1 in 6), or oxide of zinc and starch in similar proportions. If called for, the surfaces may occasionally be dressed with a weak astringent solution of alum, zinc sulphate, or acetate of lead.

Inflammation of the Mammæ

The inflammatory diseases of the udder—technically known as mammitis or mastitis—are more commonly referred to as garget, udder-clap, weed, or downfall of the udder. All cases of mammitis can readily be classified as acute, subacute, or chronic in type according to the intensity of the morbid changes in the affected gland and the degree of systemic disturbance that is present. But other classifications are permissible though more or less open to criticism. These are chiefly based on the mode of infection, the character of the causal organisms, or the morbid anatomy of the affected gland. In all its forms the disease is essentially contagious, and is specifically dependent on the presence in the mammæ of pathogenic bacteria which have gained an entrance by the teat canal, or through lesions of the integument, or have arrived in a centrifugal way from pre-existing centres of disease within the body of the animal. The responsible organisms vary in virulence and produce a type of disease in keeping with their pathogenic properties. But the susceptibility of the animal is also an important factor, and this is accentuated when influences that undermine the power of the tissues to resist attack have been in operation. In like manner the infectivity of the disease is dependent on the same causes, and is most pronounced when the attack is acute in type and associated with high fever. Infection is carried mainly by the hands of milkers, the danger of atmospheric dispersion being remote. Although mammitis received the attention of writers as far back as the early part of last century and was recognized as a serious disease of milch stock, it received no consideration from the bacteriological standpoint until 1875, when Dieckerhoff, in the *Veterinary Journal*, described an attack of septic mammitis, which he concluded was caused by a septic ferment. Two years later Zurn considered the disease contagious and not due to generally accepted causes, and at the same time Franck, of Munich, held the view that udder inflammation was chiefly caused by putrid matter, and he demonstrated the truth of his conclusions by injecting the morbid secretion of an affected udder into the teat of a sound gland, thereby setting up mammitis in twenty-four hours. His theory received much support soon afterwards from Nocard, Mollereau, Kitt, Bang, and many other continental bacteriologists, who found special organisms in the contents of the diseased organs, which they cultivated artificially, and by injecting the cultures into healthy glands induced mammitis similar in type to the original cases. It is doubtless true that, long before the light of bacteriological investigation was shed on the etiology of the disease, outbreaks were experienced in many countries, and they must have proved puzzling to observers of limited outlook, who habitually attributed the occurrence of udder troubles solely to what are now known to be contributory or predisposing causes, *e.g.* chills, exposure to cold and draughts, errors in diet, faulty construction or ventilation of the cow-shed, inefficient milking, etc. Moreover, such outbreaks as did occur would in all likelihood attain a wider spread through lack of appreciation on the part of attendants of the evil effects of unclean habits and the need for adopting proper sanitary measures of control. Since the beginning of the twentieth century veterinarians and stock-owners alike have become increasingly alive to the nature and causes of the disease, as well as the means by which it is spread, but it must be admitted that this advance in knowledge of prophylactic measures has been accompanied by little if any improvement in curative treatment. And, though the contagious character of the disease finds general acceptance in outbreaks marked by acute inflammation and rapid spread, it is unfortunate that when the type of disease is subacute and cases succeed each other at comparatively long intervals the rôle of infection is liable to be contemned, and the resultant neglect of sanitary precautions enables the responsible organisms to find a lodgment in the teats of many members of the herd. Their presence can readily be demonstrated in the first-drawn milk of the quarter. So long as the cow so infected maintains her general health and is not subjected to ulterior influences that impair the tenacity of her tissues, the organisms fail to set up mammitis, and any material increase in their number is checked when the quarter is milked morning and evening. Their opportunity only occurs when conditions arise that favour their growth and vitiate the resistance of their host. In infected herds it is a common experience to find cows defective of a quarter at the beginning of a lactation period that were considered sound when put dry a few months before. The most probable explanation of the change is that the organisms were present in the defective quarters when the animals were milked for the last time and put to grass, and that they grew unhampered in the milk secreted thereafter and altered its character. Then, through contact with the unhealthy secretion, the acini and lining of the milk-ducts would be prejudiced in the first place, and then directly attacked by the bacteria, causing a state of catarrh more or less destructive to the milk-secreting cells. The havoc produced depends on the virulence of the causal organisms; moreover, in some outbreaks of acute mammitis their pathogenicity is such that few cows, naturally exposed, escape infection, though their conditions of life are otherwise ideal, and every affected quarter is lost completely so far as future secretion of milk is concerned. Without exception the responsible organisms find in milk, at body temperature, a suitable medium for their growth and development, and they readily change the character of the milk. It is notorious that the produce of a herd in which cases of mammitis are occurring does not keep well, and if manufactured into butter or cheese these are of poor quality. This is not always the direct result of actual contamination of the produce with morbid secretion from an affected gland, which no dairyman would allow knowingly. The defect is more often dependent on the presence of bacteria in the unaltered milk, drawn from apparently healthy quarters, which have been lying in wait to set up catarrh when they found a suitable opportunity of lowered tissue-resistance. Considering the increasing demand for wholesome and pure milk this knowledge brings into relief the great importance of infections of the udder from an economical and sanitary point of view, but many problems are still unsolved which can only be successfully tackled by specialists, who should be subsidized by rating authorities. Udder diseases are peculiarly the product of uncleanness and unclean habits in the cow-shed, and where the conditions of dairying are ideal the disease is almost non-existent and the produce is usually unimpeachable. When we consider to what extent the udder is exposed, through its anatomical position, etc., to injuries and filth of various kinds replete with microbes, its comparative freedom from infection constitutes a high tribute to its defensive powers. The potential sources of infection are numerous. Immediately after calving uterine discharges soil the thighs, tail, and udder, and, if the animal is not kept clean, infection may occur by the teat canal. (The recorded occurrence of abortion bacilli in the udder may in some cases be explained in this manner.) The members of a herd are constantly liable to infection when a case of mammitis exists in the byre, and the liability is increased in the absence of sanitary precautions and particularly if the morbid secretion of the diseased gland is drawn on to the floor. Soiling of the floor, whether it be from excreta, alvine discharges, morbid udder secretion, spilt milk that has become soured, or discharges from sore feet, always begets soiling of the udder with its attendant dangers. Cases have been directly traced to bedding which had been used for horses suffering from strangles, and an examination of the contents of the diseased glands revealed streptococci, no doubt conveyed by the straw. Other cases due to streptococci have occurred in cows housed under the same roof as horses suffering from strangles. People engaged in milking cows should refrain from dressing suppurating wounds of any kind, for it is not an easy matter to disinfect hands thoroughly that have been soiled with discharges containing virulent microbes.

Predisposing Causes.—Functional activity of the udder is essentially a dominating factor, and acute cases are most commonly seen in cows recently calved, whose udders are highly congested, swollen, and tense. At this stage also they are more liable to injuries from horn-gores, blows, kicks, and the careless use of implements in the cow-sheds than later on, when they are flexible and soft. Dry stock are only occasionally the subjects of mammitis, and cases in virgin animals are extremely rare. We have already shown that eruptive diseases are most prevalent soon after parturition, and that they markedly predispose to mammitis. Other contributing factors include extremes of temperature, sudden change of climate, inordinate exertion, exposure to cold and draughts, overstocking or hefting of the gland with secretion, improper milking, leaving teats wet with milk, dirty bedding, and insanitary conditions of the cow-shed.

Infective or Specific Causes.—Various kinds of micro-organisms have proved effective in causing mammitis. They may be found acting together as a mixed infection, but it is usual to find some special type predominating in all acute cases. They reach the internal structure of the gland by one of three routes, viz.:

(1) *By the Teat Canal.*—This is by far the most common and important route. Reference has already been made to continental experiments in which pure cultures of microbes recovered from diseased glands were injected into healthy udders and caused mammitis, and by merely painting the point of the teat with such a culture mammitis has been induced, thus proving the penetrating power of pathogenic bacteria. In everyday practice it is a common experience to find cows weeded of their udders through the agency of unclean teat instruments (special or improvised) that have been introduced into the teat canal to overcome some defect that interfered with hand-milking. Kitt's experiment exemplifies the manner in which infection is commonly carried from diseased to healthy animals by the hands of milkers. The soiled hand leaves bacteria on the newly-milked healthy teat, which multiply on the milk-wet surface and find their way through the teat orifice. That bacteria are able to enter the udder by the teat canal finds further proof in the fact that the first-drawn milk from a large percentage of cows—taken with aseptic precautions—has been shown to contain a variety of ordinary atmospheric organisms whose power to produce disease has not been established. A relaxed state of the teat sphincter favours bacterial invasion in a double sense, since it allows escape of milk in which the bacteria multiply and offers a lessened resistance to their entrance into the lumen of the teat.

(2) *By the Skin.*—Infection of the udder often occurs through traumatic or eruptive lesions of the skin of the udder. The bacterial invasion is denoted by inflammation, radiating from the infected lesion, which gradually spreads along the lymphatics and subcutaneous tissue, and if unchecked the deeper structures of the gland become involved.

(3) *Vascular Infection.*—Infection by the blood or lymph-stream is very rare in the case of organisms other than the bacillus of tuberculosis. The chief venue of tubercular infection of the udder is by the lymphatics, and we have met with non-tubercular cases associated with septic conditions of the uterus and joints which we suspected to be metastatic in origin.

Causal Organisms.—Though the number of organisms proved to be culpable in setting up mammitis is small, it is likely to be added to considerably when further research and investigation are carried out. On the other hand, it is probable that identity may yet be found in several of the causal organisms that are, at present, thought to be, or are tabulated as, distinct. Those already known belong to different groups and include micrococci of various kinds, some bacilli, and the *Streptothrix bovis*. The following have been indicted, viz.:

(*a*) The streptococcus of Nocard and Mollereau, which is deemed to be identical to the *Streptococcus agalactiæ* of Kitt, the *Streptococcus mastiditis contagiosæ* of Guillebeau, and that of Hess and Borgeaud.

(*b*) The *Streptococcus conglomeratus* of P. Dubois.

(*c*) The small micrococcus of Rivolta—the cause of gangrenous mammitis of ewes and goats.

(*d*) A diplococcus—the cause of purulent mammitis in the same animals.

(*e*) The *Staphylococcus mastiditis* of Guillebeau and Lucet.

(*f*) The *Galactococcus versicolor*.

(*g*) The *Galactococcus albus*.

(*h*) The *Bacillus tuberculosis*.

(*i*) The *Bacillus lactis aërogenes*.[1]

(*j*) The *Staphylococcus pyogenes aureus*.[2]

(*k*) The *Bacillus mastitidis contagiosæ* of Carre.

(*l*) The *Bacillus enteritidis sporogenes* (Klein).

(*m*) The *Bacillus coli*.

(*n*) Guillebeau's bacillus, which is regarded as belonging to the coli group.

(*o*) The *Bacillus pyogenes* (Poels, Holth, Eggink).

Dr. Savage's investigation of 36 cases of different types of mammitis occurring in various places found streptococci responsible for 68 per cent, and a further 10 per cent were probably streptococcal, 10 per cent were due to staphylococci, and 3 per cent each to the *Bacillus coli* and the *Bacillus tuberculosis*. The records, in the bacteriological laboratory of the County of Lanark, of the results of the microscopical examination of milk samples taken, under "The Dairies, Cow-sheds, and Milk-shops Order," from indurated udders suspected to be tubercular but which proved negative, show that streptococci were present in 75 per cent and staphylococci in 25 per cent of the samples that contained organisms other than the *Bacillus tuberculosis*. None of these samples were taken from quarters acutely inflamed.

The ray fungus or actinomyces, which belongs to the class Streptothricæ, is occasionally the cause of udder disease (actinomycotic mammitis). It is said to have been proved that contagious agalactia of sheep and goats is due to an invisible virus, although various visible organisms have been found in the lesions. Further research is necessary to prove to what extent, if any, bovine mammitis may depend on ultra-visible microbes. It is not unlikely that they play an important rôle, and it may yet be shown that some of the visible microbes that are considered independent causes to-day are but secondary infections that can only operate successfully in the environment of an invisible factor. Accidental parasitism of the udder—apart from actinomycotic invasion—is not unknown. A remarkable case, recorded by Moussu, is translated in vol. xxiii. p. 212 of the *Veterinary Record*. A six-year-old Dutch cow, four months calved, had been grazing for a time on humid, marshy pastures. Though showing no marked signs of mammitis her milk was yellowish, thick, and curdled, and contained blood-coloured streaks and clots, much the same as in a case of catarrhal mammitis. When examined, actively motile parasites were found in the clots. These were reddish in colour, vermicular, cylindrical, and non-tapering, and from $\frac{1}{25}$ of an inch to $\frac{4}{10}$ of an inch in length. They were proved to be the larvæ of insects (*Chironomus*). The cow's teat sphincters were unduly relaxed, and it is thought the exuding milk attracted the larvæ when the cow was recumbent on the marshy land, and that they found an easy entrance through the wide teat orifices, carrying with them microbial germs.

Classification of Mammitis.—The disease has been subjected to various classifications, all more or less useful but mostly open to criticism. An etiological classification, embracing the terms streptococcal, staphylococcal, diplococcal, bacillary, tubercular and actinomycotic mastitis, will not be satisfactory until the bacteriology of mammitis is better understood. In the light of further research it is not unlikely that we may be able to distinguish with some accuracy the specific effects of the different organisms that most commonly cause mammitis in all animals. When that time arrives, and it has become practicable to apply specific sera and vaccines for the prevention and cure of the disease, an etiological classification will doubtless prevail. We have already much knowledge in this connection as to some subacute and chronic infections, but there is much room for investigation in regard to acute forms of the disease. Some observers differentiate cases according to their pathological anatomy, adopting the following terms:

(*a*) Catarrhal mammitis, in which the lining of the milk-sinus and ducts is chiefly the seat of disease.

(*b*) Parenchymatous mammitis, when the

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[1] Gilruth and M'Donald, *Veterinary Journal*, April 1911.

[2] Patterson and Begg, *Hoare's Veterinary Medicine*, vol. i. p. 380.

essential milk-secreting tissue or parenchyma of the gland is affected, and

(*c*) Interstitial, phlegmonous, or lymphogenous mammitis, wherein the infective process begins at a lesion of the skin and involves the subcutaneous lymphatics, the perimammary subcutaneous tissue, and later the interstitial tissue that forms the septa or partitions between the lobes of the gland.

In certain mild infections by the teat canal the disease does not advance beyond the catarrhal stage before recovery takes place, and similar remarks apply to benign forms of infection beginning at the integument. To such the terms catarrhal mammitis and interstitial mammitis truly apply, but classification based on pathological anatomy is only possible at the earliest stage of the disease, for in all acute cases the infection proceeds within a short time into all the tissues of the gland, when the whole of the terms are applicable. The chief fault of this classification, therefore, lies in its early failure. Other designations which explain their own application are occasionally used, *e.g.* metastatic, suppurative, and gangrenous or sloughing mammitis. But the disease in the cow can be studied most comprehensively and easily when cases are differentiated according to the virulence of the pathogenic process and the clinical symptoms, when they readily fall under the following heads, viz.: subacute, acute, and chronic mammitis.

Subacute Mammitis.—Cases of mammitis may be considered subacute when the inflammatory process is mild and shows tendency to early resolution. It is seen at all stages of lactation, and is due to causal organisms whose power of attack is not greatly pronounced, being to a great extent dependent for success on the operation of a marked contributory cause. The infection may begin at the skin, but usually it occurs by the teat canal, where it may have been held in abeyance for many weeks until tissue resistance has been reduced by some prejudicial factor. The bacteria then gain the mastery, alter the character of the milk, and set up a catarrhal condition of the milk-ducts and, it may be, some degree of inflammation of the secreting cells.

Morbid Structural Changes.—When infection begins at the skin there is exudation into the subcutaneous cell-tissue and lymphatics, and this may penetrate some distance into the interlobular connective tissue of the gland. With infection by the teat the lesions are at first confined to the sinus and milk channels. Their lining membrane is first congested and then thickened by exudation into the submucous coat, the result of the irritant action of the bacteria and their products. Epithelial cells are abundantly shed into the lumen of the ducts and are held up in the clots of abnormal secretion, and occasionally there is extrusion of granulation tissue which gives immediate and future trouble in the process of milking. In better-developed cases the parenchyma of the gland is more or less involved.

Symptoms.—Constitutional disturbance is not well marked. Appetite and rumination are little altered, the temperature is only slightly raised, and the activity of the udder is not much impaired. Locally, in cases beginning at the surface of the organ, there is redness of the integument and a radiating œdema, but the milk is unaltered and early treatment is followed by complete recovery in a short time. In subacute catarrhal mammitis the local manifestations are, at first, slight tumefaction of the teat and the glandular tissue at its base, with more or less marked tenderness in manipulation. The secretion may be unchanged in colour, but small clots are observable when it is examined in thin film. Later on these changes are better developed, the secretion loses its whiteness and consists of yellowish serum and clots of casein containing cells shed from the mucous coat of the ducts. Pain and swelling are increased, but under suitable treatment the attack soon recedes and the milk gradually becomes normal in appearance. It should not, however, be put into use for some time thereafter, as it would influence the keeping quality of the produce of the dairy. The future milk-secreting capacity of the affected quarter is lessened according as the secreting cells have been destroyed by the attack. In some cases when the cow calves again the evident loss of function shows some improvement if the defective quarter be milked first for a time, but the rule is to find the atrophy and lessened activity as persistent and permanent features that become more and more pronounced as the lactation period advances.

Acute Mammitis.—Acute forms of udder disease are more frequently met with during the first month after parturition in all animals, especially in primiparæ, than at any other time. Indeed, as already explained, the process is in immediate relation to the function of lactation, the virulence of the bacterial attack being at all times enhanced by the susceptibility of the animal, during the parturient period, to suffer shock from influences to which she is more resistant later on. According to the venue of origin of the infection, the attack in its initial stage involves only the milk-ducts (catarrhal mammitis) or the subcutaneous lymphatics and septa of the quarter (interstitial mammitis), but the implication of the whole quarter is soon accomplished when the point of attack cannot be clearly determined. In infection via the teat—the more common entrance—the incubation period is short, from twenty-four to forty-eight hours. The milk of the previous evening may have shown no change, yet the following morning the product of the painful quarter is radically altered in character, the result of bacterial activity. Through contact with diseased secretion the mucous membrane of the ducts is vitiated, and the bacteria are able to force their way through to the deeper structures, which become involved, to the confines of the affected quarter or even beyond this to a neighbouring quarter if the envelope of the gland be not intact. Conversely, when acute infection begins at the skin the quarter may be much swollen and painful for a brief period, during which the milk is scarcely altered, but by active penetration of the bacteria the acini and ducts are soon included in the inflamed area and the product of the quarter becomes as diseased as if infection had come by the teat canal.

Morbid Structural Changes.—As the disease is practically never fatal in its first stages, pathologists have had little opportunity to examine and describe the early morbid anatomy of mammitis, naturally acquired. The naked eye appearance of the cut surface necessarily varies according to the point of origin of the infection. Following teat infection it is evident that there is a gradually extending sclerosis or thickening of the lining of the teat, the sinus, and milk-ducts, and congestion of the surrounding tissues. Later, there is infiltration of the deep structures with inflammatory exudate and tumefaction of the teat, and the appearance of the cut surface of the gland indicates that the interstitial tissue is the chief seat of inflammation. It is yellowish in colour and punctuated by small areas of extravasated blood. Owing to the pressure of the exuded material the acini and blood-vessels are more or less compressed, causing grave vascular disturbance which often amounts to blood stasis causing patches of gangrene that gradually increase in size. When this has occurred the structure is dark-coloured and evil-smelling, and when cut into, a noisome, dark, septic fluid escapes which is tinged with secretion. Gangrene may be diffuse or circumscribed, and in the later stages the line of demarcation between the living and dead portions of the gland is very evident. When vascular changes occur more slowly the interlobular connective tissue becomes greatly thickened and fibrous, giving the surface a marbled appearance, purulent foci appear here and there, and these gradually enlarge and coalesce to form considerable abscesses, which may point externally or into the milk-sinus. We have occasionally seen the whole interior of the quarter transformed into a huge pus cavity. The microscopical appearances of the diseased tissues in all stages admit of lengthy description, but are only of interest to the pathologist.

Symptoms.—The constitutional symptoms of acute mammitis appear with startling suddenness and severity. It often happens that a violent shivering fit first draws the owner's attention to the fact that a deep-milking cow has been seized with mammitis. The animal stands with hair on end, straddling and restless, with a full, frequent pulse and temperature as high as 106° or 107° F. Respiration is short and quick, the countenance is dull and anxious-looking, appetite and rumination are suspended, and it is only occasionally that she will take a little fluid. Not uncommonly there is slight tympanites and irregularity of the bowels. The body surface is alternately hot and cold, and though she becomes leg-weary she finds no rest when recumbent owing to the painful state of her udder.

The *local* signs in cases beginning with catarrh are early tumefaction of the base of the teat and congestion and enlargement of the quarter. The whole surface of the quarter is red and soon becomes reddish-purple in colour, turgid and tense, and so painful that the animal frets at the slightest interference. In many cases only a little yellowish serosity can be drawn from the teat, and this contains many bacteria. At subsequent strippings small flocculi of casein appear in the secretion, which gradually becomes altered in colour and consistence from the presence of blood elements, epithelial and pus cells, and the material has a repulsive appearance and odour. Though, under treatment, the constitutional symptoms abate to some extent in a day or two, the diseased process in the quarter advances through different stages. If the teat is not unduly tumefied, an increasing quantity of morbid secretion is available, and its appearance becomes more and more pus-like. But if the teat be defective from extreme tumefaction or other cause, so that little or nothing can be drawn from the quarter, the suffering of the animal is intense and gangrene may supervene. This is first evidenced by coldness, stiffening and change of colour in the teat and integument of the quarter around the base of the teat, which gradually assume a purple or greenish-black hue and the skin peels off when handled. If not quite obstructed, the teat yields a few streams of blackish fluid of putrefactive odour. If the gangrene be clearly circumscribed, septic intoxication may not occur, and the part becomes demarcated and eventually is cast off by the healthy tissue, leaving an irregular, angry-looking cavity which soon heals up. Occasionally it happens that the larger nutrient vessels of the mortified zone are not completely involved and protrude as bleeding stumps from the raw surface, and if not ligatured and removed they are rapidly ensheathed in a thick coating of sensitive and vascular granulation tissue, impeding the closure of the wound. But when mortification is diffuse and penetrating the condition of the animal is exceedingly grave and death becomes imminent. The septic state of the blood is accompanied by marked prostration, the internal and surface temperatures become subnormal, the pulse almost imperceptible, respiration short and frequent, and the enfeebled animal soon goes off her feet and a quiet death ensues. Abscess formation is, however, a much more common sequel to acute mammitis, and, though it is responsible for disastrous local results, the dissipation of systemic disturbance is accompanied by an increasing restoration of function in the healthy quarters of the udder. After some time or at a subsequent lactation it is not unusual to have compensatory hypertrophy and increased functional activity in the quarters that remain. But, in certain cases, the disease invades a second or third quarter either by extension or teat infection, the period of illness is much prolonged, and the cow becomes a wreck. When a cow survives an acute attack the affected quarter continues for a time to yield a quantity of purulent material, but later on it dries up and becomes atrophied. In rare cases, occurring towards the end of lactation in pregnant animals, the diseased process recedes in activity and becomes latent when the cow goes "dry," but when function is restored again at calving time the unexhausted infection is reactivated, the animal sickens anew, and her utility is seriously discounted. Such cases are fruitful of disputes between buyers and sellers of dairy-stock. In acute mastitis originating through infection at the skin, though the constitutional symptoms are as alarming as those described above, the local changes are different in the early stages. The perimammary tissue of one or two quarters becomes markedly infiltrated with exudate, causing a painful œdematous swelling that pits on pressure, and the skin is reddish and tense. The swelling may extend anteriorly and posteriorly beyond the limits of the udder. At first, and for a shorter period than in subacute forms of the disease, the secretion is little changed, but the infection soon penetrates to the lobular tissue and the product of the quarter is radically altered. Superficial abscesses may form, and patches of the integument occasionally lose vascularity, die, and are cast off. Deep-seated abscesses, which are at first difficult to detect, may also form and cause much destruction of the mammary tissue. Under proper treatment it is sometimes possible to abort an acute superficial infection.

Complications.—Digestive disturbances are usually apparent at first, tympany may be evident, and the bowels constipated. Of local complications gangrene is the most serious and abscess formation the most common. The induration of tissue that is always present during and after the attack gives place to a more or less complete wasting of the gland, but knots of hardened tissue usually persist. Secondary arthritis (inflammation of joints) is not unusual, and in our experience this occurs at a time when the acuteness of an attack due to streptococci or *Bacillus pyogenes* has passed off and an almost chronic state of suppuration exists in the gland. The joints most often affected are the hocks and the fore and hind fetlocks, in the order named. Usually the first sign is a slightly painful swelling on the flat of one or both hocks, often a little more pronounced in one than the other, which makes the cow less willing and less able to rise. The swelling increases and the capsule of the joint becomes distended, the hollow of the joint being bogged with a tense, globular, and painful swelling. This makes the animal ill at ease when on her feet and relief is sought in the recumbent position. The difficulty in rising occasioned by prolonged flexion of the painful joints is such that animals so affected have often been treated blindly for paralysis, and ineffectual attempts to get up often beget bruising of the brisket against the feeding-trough, and the resulting swelling has been mistaken for that seen in advanced cases of traumatic pericarditis. When the fore and hind fetlocks are also involved the animal is so sorely crippled that she can only stand in a fidgeting manner for a few minutes at a time, and, owing to her pyæmic state and constant lying, bed-sores result which are sometimes the seat of extensive suppuration. Fortunately the pain in the joints is not difficult to relieve if treated early.

Chronic Mammitis.—Under this head we include those forms of the disease characterized by the minimum of constitutional disturbance and some degree of slow persistent induration, or by the gradual formation of abscesses in different parts of the quarter. In many cases it is the relict of an acute attack.

Structural Changes.—The indurated quarter is fibrous and hard to cut and the exposed surface is yellowish in colour and coarsely nodular in appearance. The interlobular tissue is greatly thickened, the acini are crushed and wasted, and here and there small foci of suppuration are seen hemmed in by hardened walls of fibrous tissue. It would seem that the responsible streptococci were not sufficiently aggressive to set up extensive suppuration and that tissue resistance prevailed, as evidenced by the formation of a dense sclerotic wall around each centre.

Symptoms.—Little or no constitutional disturbance accompanies chronic mammitis. When it is not the result of an attack of acute mammitis, in which case there is a fairly uniform and hardened state of the whole or a large part of the quarter, the first sign of infection is the appearance of one or several nodules in the udder tissue near to the base of the teat. They gradually increase in size and number, with no great tendency to become confluent, and the quarter at this stage feels like a bag of small tumours. The secretion is reduced in quantity, though at first apparently normal in quality. It does not keep well and it soon changes in colour, contains small clots, and is unfit for use. Under certain conditions, favourable to the reproduction of the causal organisms and the activity of their life-products, the inflammation becomes more acute, induration proceeds more quickly, accompanied by increase of pain and a variable degree of constitutional disturbance. Abscesses form slowly and burst externally or into the milk-sinus and ducts, when almost pure pus is got by stripping the teat. In other cases the indurated parts remain hard until the cow goes "dry," when resolution and atrophy occur, and the future milk-yield of the affected quarter depends on the extent of destruction of the acini which has taken place.

Treatment of Mammitis. (*a*) *Prophylactic.*—During the last decade practitioners and owners have become increasingly alive to the great and primary value of preventive measures against a disease so insidious in its spread and unresponsive to remedial treatment. Scrupulous cleanliness is the sum of these measures, and when this is given effect to, the beneficial result is not limited to the prevention of udder disease but ensures the accomplishment of a pure and first-quality milk supply. Whatever the causative agent may be, the prophylactic, and to a great extent the curative, measures remain the same. General measures include proper housing, thorough disinfection of the cow-shed two or three times a year, and removal of defects in the floors, etc., of stalls. Attendants should wear clean overalls when milking, their hands should be washed clean before, and at repeated intervals during, milking, and the finger-nails kept short. The teats and under surface of the udders should be swabbed with a cloth wet with antiseptic solution, and then dried with a clean cloth before milking. If the udder, tail, and hind parts of the cow be soiled, actual washing and disinfection are essential. The little trouble that this entails ensures the minimum of contamination of the milk from falling debris, and the teats are rendered more pliable. After milking, the teats and udder should be dried with a cloth. Milkers should not be allowed to dress suppurating sores of any kind if direct carriage of dangerous organisms to the teats is to be avoided. If milk be unavoidably spilt on the floor it should be cleaned up at once. Cows newly bought should be housed separately until the absence of udder disease is proved. The purchase of newly-calved or due-to-calve cows defective of a quarter is to be avoided unless the quarter is completely atrophied and dry or its secretion is guaranteed fit for use. When the disease has appeared special measures are called for. Affected cows should be isolated and have a special attendant who understands the value of antiseptic precautions. He should milk the affected quarter last, using a special pail containing some antiseptic, and the material should be burned or buried. The produce of the apparently healthy quarters of each cow should be kept separate and tested as to quality and, if necessary, it should be sterilized or actually boiled and fed to pigs. If facilities for isolation are awanting and the infection is extremely virulent, as revealed by the nature of the first case or two, and especially if attendants are unreliable, slaughter of the affected cows is worthy of consideration as a measure calculated to abort the outbreak. All ordinary sanitary measures should be redoubled when disease exists or has existed, there should be complete local and general disinfection, and repair of broken parts of the floor should be carried out. We have already indicated the dangers that attach to the use of soiled milk-tubes and other teat instruments, and referred to the precautions necessary. In this connection negligence in the care and use of instruments employed in inflating the udders of cows suffering from milk-fever has not uncommonly been the cause of mammitis. This is quite avoidable if the instruments are properly sterilized before and after use. A careful examination of the quarters is also needed to detect any evidence of existing catarrh. If this be neglected and the product of one quarter is soured, infection is sure to be carried to the quarters inflated subsequent to the affected one. When cases of mammitis have occurred in a herd we may presume that the udders of some other members of it contain latent infection, and the need for efficient and complete milking is imperative. Overstocking is a potent factor in setting up disease in udders that are harbouring bacteria.

(*b*) *Curative.*—Acute mammitis is singularly intractable to curative treatment, though much may be done to lessen constitutional disturbance and modify the course of the disease in its different stages. Subacute cases are more amenable to remedial measures. The force of the attack indicates the extent to which internal remedies are called for. The first essential is to isolate the patient and have her housed and clothed comfortably. Bleeding is only permissible in plethoric animals when fever runs high, and, if practised, the blood should be taken from the jugular and not the mammary vein because of the risk of infection to a wound that would have contact with the floor. The shivering fit is to be controlled by the administration of half a pint of whisky in water, and purgation should be induced by giving a pound of Epsom salt, which has a salutary effect on the activity of the disease and lowers the function of the udder. For less robust animals it is sufficient to give repeated smaller doses in gruel or drinking-water. Potassium nitrate in 2-drachm doses may be given in the same way twice daily, and if an internal antiseptic is called for, there is none better than formalin in 1-drachm doses well diluted with water. If the temperature remains high, recourse may be had to antifebrin or acetyl-salicylic acid in 2 to 3-drachm doses placed on the back of the tongue with a dry metal spoon and washed over with a little water. The latter drug is called for when arthritis complications appear. The diet should be sparing and easily digested: bran mash, light gruel, roots, and hay. Richer feeding-stuffs, though preferred by the patient, increase lactation and put an unnecessary strain on the quarter affected.

Locally.—Pain is relieved by continued hot antiseptic fomentations and gentle massage, to be followed by rubbing in some mildly stimulating, antiseptic, or anodyne liniment or ointment and stripping of the teat. Poultices of linseed, bran, marsh-mallows, or hops are held in high repute in some districts, but they may be superseded with advantage by cataplasms of kaolin and glycerine, whose antiphlogistic effect is undoubted. The tin containing the material is put into a hot-water bath, and when it reaches blood-heat it is thickly spread on the inflamed quarter and covered with a layer of cotton-wool, gamgee tissue, or a piece of flannel. It may be renewed every twelve hours, and should be held in position by means of a many-tailed suspensory bandage fastened over the animal's back, and provided with an aperture that leaves the teat bare, so that it can be stripped every two hours without interfering with the dressing. The support of the bandage gives additional comfort to the animal. Local applications that find favour in the early stages comprise mustard and water, and liniments or ointments containing belladonna, opium, camphor, spirit, etc., the basis of which may be vaseline, lard, lanolin, glycerine, white of eggs, soap liniment, soft soap, or embrocation, etc. Their use not only prevents loss of heat but facilitates massage, which should be gentle or firm according to the tenderness of the quarter. Care is essential to avoid injury to the teat and skin of the udder by the use of fomentations or poultices that are too hot or dressings that are too irritating. The use of teat-syphons is to be condemned.

When pain subsides, resolution is assisted by the application of iodine ointment, painting the part repeatedly with tincture of iodine or rubbing in a little red iodide of mercury ointment, the teat being first smeared with pure vaseline, lanolin, or lard. Every effort must be made to maintain a healthy effective teat that can withstand the necessary forcible stripping. If its utility be lost and suppurative discharge accumulates in the quarter the teat may be amputated at the root, a local anæsthetic being used. This gives immediate and perfect drainage, which may be assisted by exercising the cow, massaging the udder, and forcibly injecting the cavity with tepid antiseptic solutions. Where abscess formation is evident, fomentations or poultices may be used with advantage, and when fluctuation can be detected the abscess should be opened with much caution, because of the tendency to excessive bleeding when too free incisions are made into an organ so vascular and pendulous. To lessen the danger of hæmorrhage, many practitioners prefer to open mammary abscesses with a hot-pointed firing-iron. When gangrene occurs and is limited or well circumscribed, with no marked evidence of intoxication, we may wait the spontaneous elimination of the part, assisting the process by means of fomentations containing permanganate of potash. But if it shows a tendency to become diffuse the patient should be cast and the dead tissue removed by operation before septic intoxication has set in. Joint complications should be dealt with heroically, and the early application of blistering ointment, well rubbed in, affords speedy relief from the pain that keeps the cow abed. Milder applications are too slowly effective, and in heavy, lymphatic, and recently-calved cows disaster quickly follows continued lying and ineffectual attempts to get up. When hocks are dealt with they must be clothed to prevent blistering of the teats, while blistered fetlocks should be covered and smeared with aloes solution or manure to prevent licking of the parts. The risk of strangulation when the cow makes awkward attempts to rise is minimized by having a string link put in iron binding-chains and filling the dung-channel to the floor-level by placing in it an inverted wooden rone fashioned to the capacity of the gutter.

Treatment by Intramammary Injection of Antiseptic Solutions.—Bigoteau in 1905 published the results of systematic treatment of mastitis with injections of boric acid solution, and this plan has been extensively adopted since then in France and elsewhere, a 4 per cent solution being used. He declared that the treatment can only be successful when the diseased quarter has been completely emptied of secretion before the injection is made, and he believed that all forms of the disease in the cow are equally amenable to treatment if his directions are carefully carried out. The solution is injected at body temperature, the quarter being comfortably filled and gently massaged during the process, and the operation may be repeated at intervals of two to four days. In our experience the greatest difficulty to be encountered is the perfect emptying of the diseased quarter before injecting, especially in virulent forms of the disease occurring at the height of lactation and characterized by tumefaction of the teat and great pain, so that the dislodgement of clotted material is impossible and only a little liquid secretion can be obtained. Under such conditions no good results follow the use of boric injections, but we have often been satisfied with their efficacy when the state of the parts permitted proper emptying of the gland. For virulent mastitis, Schmidt, of Kolding, Denmark, the famous originator of the udder treatment of milk-fever, recommends the infusion into the quarter of 4 ounces each of alcohol and glycerine, and if the affection is not too severe he adds to this 3 ounces of normal salt solution. The affected quarter is not milked out during three days after the infusion. If two or three quarters are affected, only one is to be dealt with at a time, and it is said that substantial improvement is apparent in four days and the animal's life is preserved, though milk-production is not always restored.

Treatment by Serum and Vaccines.—The rational consideration of the problem of dealing with mammitis by means of serum or vaccine, or both, suggests the initial use of a hyperimmune animal's serum in all cases characterized by marked illness and high fever. These symptoms betoken a high degree of reaction in the animal's economy to the toxic products absorbed from the seat of disease, and the use of a vaccine at this stage would render the reaction more profound and perhaps insupportable. In the more chronic forms of the disease the use of vaccine is indicated. But the results of such attempts as have been made with vaccine have not been very encouraging. The anatomical conditions are, to some extent, opposed to the success of vaccine therapy. The infecting organisms, especially in the early stages of cases set up by way of the teat canal, are chiefly located outside of the mammary tissue though within the lumen of the ducts and acini, where they multiply and produce their toxic products. In that position they are but little amenable to the influence of body fluids fortified by vaccine treatment. Good results cannot be expected from the use of ordinary stock vaccines of dead organisms whose identity with the causal microbes of the particular cases to be treated has not been proved. The time is ripe for the preparation of an antimammitis serum for use in acute cases, a serum obtained by hyperimmunizing with several strains of the organisms found in actual cases of the disease, so that the antiserum may be polyvalent; also for the preparation of mixed vaccines derived, for preference, from a variety of strains, for use in the more chronic forms of the disease. Their application should be accompanied by the use of a solution of citrate of soda or of common salt injected at body temperature into the affected gland, and the administration of citric acid in 1-ounce doses, a sufficiency of common salt being allowed in the food or drinking-water. These means are calculated to increase the flow of serum from the diseased gland. It has been suggested to us, and it would seem feasible, to attempt early treatment of cases unaccompanied by much fever by making use of the culture procurable from the diseased gland. Such an experiment might be made by straining the secretion drawn from the teat, sterilizing the filtrate by heat at 60° C. for twenty or thirty minutes, or by the addition of an antiseptic such as 0·5 per cent solution of tri-cresol or microbene, and vaccinating the animal with a suitable dose of the prepared material. Experiments are also indicated, in cases showing the minimum of systemic disturbance, to try the effect of the oral administration of the product of the diseased gland as soon as it is drawn off, the dose being regulated by the effect produced.

Mammitis in Mares.—The mare is rarely affected with mammitis, and this is not surprising when we consider that her udder is not subject to many of the influences that beget the disease in the cow. The equine udder is also more favourably situated to escape contamination from the ground, and it is comparatively little exposed to infection from human hands, though it cannot be considered more resistant to the attack of disease-producing germs. The disease may be seen prior to parturition, but it usually occurs during lactation, and cases have been met with in animals whose foals were weaned early while the udder was still active. It has also been observed in virgin mares. Almost without exception investigated cases have been due to streptococci, and acute forms of the disease usually end in abscess formation. Diseased conditions existing in the foal are usually responsible, *e.g.* strangles, suppurating sores on the head, etc., and abnormal states of the interior of the mouth. Bermbach saw two cases in the mothers of foals affected with strangles, and Lucet, Schutz, and Parent found streptococci in the secretion taken from cases of equine mammitis. J. F. Healy, of Middleton, in the *Veterinary Record*, January 24, 1903, reports having met with twenty-three cases in mares during the months of June, July, and August 1902 within a radius of ten miles.

Symptoms.—The general symptoms include uneasiness, marked stiffness in the hind limb of the side affected during progression and when turning, and intolerance of the attention of the foal. The pulse is frequent, full, and strong, and the temperature may rise to 105° F., accompanied by rigors.

Locally.—One or both sides of the organ are the seat of much swelling and pain, the integument being hot, tense, and shining, and the teat or teats tumefied and stiff. Accompanying œdema often extends fore and aft to the abdomen and the perineal region. The secretion is changed in character and at first is often reddish-black in colour and disagreeable in odour. Later, it becomes more pus-like. The pathological process usually ends in abscess formation and induration, but gangrene occasionally occurs. Though the formation of abscesses is the natural result of all acute streptococcal infections, there is, in some subacute cases of a catarrhal character, a slowly-developing induration and enlargement of the affected gland, which is changed into a hardened, fibrous mass. This condition often becomes chronic, though by and by the dimensions of the gland decrease. This is also true of the bulky induration that invariably succeeds abscess formation. Occasionally we have seen the formation of abscesses so prolonged that the process assumed a botryomycotic character. If early treatment is adopted the progress of the disease can be much modified, but the function of the affected gland is always destroyed. When gangrene occurs death often follows, but in some cases the dead part is cast off and the mare recovers.

Prognosis is always unfavourable for the reasons mentioned above; the foal has to be fostered, and the mare is unlikely to succeed in rearing future offspring.

Prophylaxis.—Heavy-milking mares are difficult to put dry at weaning-time. They should be physicked to lessen functional activity, or should be put into suitable constant work, and, if necessary, the udder should occasionally be unloaded by hand to prevent overstocking. The udder may be rubbed with vinegar or painted over with a solution of extract of belladonna.

Treatment.—The patient must be comfortably housed and clothed, and should receive from 10 to 12 ounces of sulphate of soda or magnesia in solution, followed by febrifuges and diuretics such as antifebrin, salicylate of soda, or acetyl-salicylic acid in 2-drachm doses, and small doses of potassium nitrate in the drinking-water. The local treatment required is essentially the same as for bovine mammitis. (See p. 1043.)

Mammitis in the Bitch.—Acute and chronic forms of the disease occur in bitches, and the former often give place to the latter. The mammæ of the bitch are much subject to soiling through contact with the ground, and they often suffer from overstocking through wanton and early removal of undesired puppies when functional activity is at its height.

Symptoms.—The usual signs of systemic disturbance prevail. The animal lies on her side stretched out, is very sick and feverish, and refuses food. The affected glands are hot, painful, swollen, and œdematous, the secretion is altered and soon becomes purulent, multiple abscesses form and burst leaving ulcerating wounds or fistulæ, and not infrequently pyæmic conditions supervene and the animal dies. A condition of chronic induration often succeeds acute mammitis in dogs, and a productive form of chronic mammitis causing enlargement and hardening of two or more glands occasionally results from neglect of conditions of functional activity that frequently recur in some non-pregnant bitches.

The tumour-like condition of the indurated glands is in most cases innocent, but carcinomatous transformation has been known to occur.

Prophylaxis.—The floor of breeding-kennels should be kept in a clean, sanitary condition, and before and after parturition the mammæ should be sponged over with an antiseptic solution and dried. If the puppies are not to be reared, they should be removed gradually so that the loss of function may be gradual. Scratches and sores on the mammæ should receive proper antiseptic treatment.

Treatment.—This comprises proper housing, the administration of a purge, warm antiseptic fomentations carried out by making the patient stand in a tub of warm water to which an antiseptic has been added, and applying it by means of a sponge. Or cataplasms of kaolin and glycerine may be used, kept in position by bandages. Stripping of the teats of affected glands must be practised, and the offspring should be removed and the healthy glands milked by hand. Massage with an anodyne ointment or liniment is useful when pain is less marked, the stripping of the teats being continued. When abscesses form they should be opened and treated antiseptically, and when indurated glands are unduly large and pendulous they may be extirpated by operation without fear of regrowth in most cases.

Mammitis in the Sow.—Though occasionally seen, mammitis is rare in the sow, and is almost unknown in brood animals that are well housed and cared for. Sows are mostly affected shortly before or after farrowing. Cases occur when they are allowed to roam about on broken ground in cold weather. The mammæ reach close to the ground, and are liable to suffer injury through contact with large stones, rough logs of wood, loose barbed-wire, and other obstacles. When brood sows are allowed out in frosty weather, with snow on the ground, the mammæ find contact with the frozen snow and become frost-bitten here and there, when sores result that often involve the teat. Infection of one or more glands readily follows. The progress of the disease and the measures necessary for treatment are in all respects the same as in the bitch.

Gangrenous Mammitis of Ewes.—This disease has been recognized in many countries. It has been known in France for the greater part of a century, it occurs in Italy and Germany, in England it is known as "Black Udder," and Gilruth has published his investigations regarding the disease as it occurs in New Zealand in the *Veterinary Journal*, 1910, p. 648. All authors agree as to the infectious nature of the disease. The *Cause* of the disease was discovered by Rivolta in 1875 to be a specific and minute micrococcus, which in 1887 was studied to greater extent by Nocard. The organism gains access to the glands through the teat or lesions of the skin.

Structural Changes.—The inflammatory exudate infiltrates the skin and subcutaneous tissue, causing extensive œdema. Soon there is evidence of gas formation in the tissues and gangrene. Only a little red fluid can be got from the teat, and the cut surface of the diseased gland resembles that of half-cooked meat.

Prognosis is always grave. If the affected gland is not extirpated before sepsis occurs the disease is almost sure to prove fatal.

Symptoms.—The onset of the disease is sudden and its progress speedy, indicating the operation of highly aggressive bacteria or low resistance of the ovine mammæ, or both. The local and general symptoms are therefore simultaneously evident. The affected ewes become segregated and move about painfully, refusing the attention of their lambs, and the temperature is much increased. Meanwhile, the affected gland—usually one only—is swollen and œdematous, hot and painful, and the secretion is reddish. Emphysema (gas formation in the tissues) and gangrene of the part soon follow, as indicated by the appearance of violet-coloured cold and insensitive patches on the skin, and the product of the gland is reddish-black and offensive. Septicæmia of an acute type is now evident, temperature is subnormal, the animal remains recumbent, suffers from rigors, grinds the teeth, and dies in two or three days. In rare cases the area of gangrene is limited and the part is cast off, leaving an indolent suppurating sore. In non-fatal cases the recovery is extremely protracted.

Prophylaxis.—Affected ewes should be isolated and their surroundings disinfected. The whole flock should be dipped and put in new and sheltered pasture in charge of a new shepherd.

Treatment.—Complete ablation of the affected gland is the only safe procedure, but in some cases free incisions may be made into the gland, the cuts being packed with crystals of permanganate of potash and cotton-wool, or swabbed with strong antiseptic solutions. Esser and Moussu have repeatedly amputated the dead part with success. Bridré has successfully practised immunization with an attenuated culture of the micrococcus in bouillon. He also found that the blood serum of hyperimmunized ewes possessed protective properties.

Mammitis in Goats.—Two types of the disease are met with in goats: gangrenous and purulent.

(*a*) **Gangrenous Mammitis.**—This disease is almost identical to that occurring in ewes, as proved by Nocard, Leclainche, Mathis, Leblanc, and Moussu.

(*b*) **Purulent Mammitis** is usually seen soon after parturition. It is said to be due to a diplococcus that has a tendency to form chains. The disease develops more slowly than the gangrenous type, though characterized by acute inflammation. The usual general and local symptoms that accompany the process of abscess formation are present. After the abscesses burst the resulting sores discharge for a time, and when this ceases a considerable degree of induration remains.

Prophylaxis consists in isolation of the infected and disinfection of the premises, and the dressing of the mammæ of all in-contact goats with antiseptic solutions.

Treatment.—Pointing abscesses should be opened carefully and the purulent cavities suitably treated with antiseptics.

Actinomycosis of the Mammæ.—Mammitis due to the ray fungus (actinomyces) has been observed in the cow, the sow, and the mare. It is also said to have been seen in the human subject—the result of the extension of pulmonary actinomycosis through the chest-wall; and poultices have been blamed for some superficial cases of the disease. That the disease is common in the sow is evidenced by the fact that Rasmussen and Bang saw fifty-two cases in Copenhagen abattoirs in three months. The same authors and other continental observers have found the disease in the cow. Cases are also recorded by Williamson[1] and Henderson and Patterson.[2] Dr. J. H. Patterson, County Bacteriologist, Lanarkshire, examined about fifty udders of cows for suspected tubercle and found forms of actinomyces in five specimens, in one of which there existed a double infection, tubercle bacilli being also present. To the naked eye the tubercular nodules were indistinguishable from those of actinomycotic origin. We believe that further investigation will show that the disease in the cow is more common than might be concluded from published records, and the author has suspected its existence in the udders of many live cows that he had no opportunity of examining after slaughter. In the milk samples taken from one or two such cases Patterson detected the elements of actinomyces. The animal's bedding is probably the source of infection, the fungus gaining access to the udder by the teat.

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[1] Williamson, *Veterinary Journal*, 1899.

[2] Patterson, *Journal of Meat and Milk Hygiene*, January 1911.

Structural Appearances.—The affected udder of the live animal has a shotty or nodular feeling when palpated that is not dissimilar to that of some rare cases of tubercular mammitis. The cut surface of the gland is yellowish-brown in appearance and shows numbers of cream-coloured foci from the size of a pea or smaller to that of a marble. The nodules protrude from the surface, and where softening has occurred the characteristic yellow particles are observable. Actinomycosis of the udder is important from the public health point of view, since the product of the affected gland may, and often does, contain the fungus.

Treatment.—In the pig, extirpation of the affected glands is called for. The specific effect of iodine in actinomycosis indicates the internal administration of the drug, but cows suspected or known to be affected with udder actinomycosis should be fattened for slaughter.

Tubercular Mammitis.—Tuberculosis of the mammary gland in the human subject was first described by Sir A. Cooper in 1836, and Fünfstuck in 1870 was the first observer to refer to bovine mammary tuberculosis. Since then the disease has been much investigated by many continental observers. No one has given the condition closer study than Sir John M'Fadyean, and we are indebted to him for his latest and most erudite dissertation on the subject in vol. xxx. of the *Journal of Comparative Pathology and Therapeutics*, which will be accepted as standard. "Tuberculosis of the udder" was one of the forms of the disease included within the scope of the Tuberculosis Orders of 1913 and 1914 (presently under suspension). Before then, some local authorities, acting under the provisions contained in Article 15 of the Dairies, Cow-sheds and Milk-shops Order, 1885 and 1899, carried out systematic veterinary inspection of dairy herds within their areas for the detection of cows suffering from this form of tuberculosis.

Routes of Infection. (*a*) *By the Blood Stream.*—M'Fadyean has concluded, contrary to the expressed views of most authors, that infection by the blood stream cannot be the method of infection in ordinary cases for the following reasons, viz.:

(1) The disease usually begins in one quarter and not in all four quarters.

(2) In the majority of cases a hind quarter is first attacked.

(3) The disease generally appears to have begun at the upper part of the quarter.

(4) The lesions, as a rule, do not seem to develop from separate discrete centres in the quarter first attacked.

(5) In certain cases the supramammary lymphatic glands are found to be visibly tubercular, while the udder-tissue appears to be normal. He does not deny that infection by the blood stream does occur in animals affected with generalized tuberculosis in which considerable numbers of bacilli escape into the blood stream and become arrested in the capillaries of the udder. He concludes, however, that in such cases death must occur before the bacilli have time to cause the formation of tubercles visible to the naked eye. His deductions in regard to ordinary cases of mammary tuberculosis are well founded, and no fault can be found with the general application of his remarks on the incidence and course of cases of miliary tuberculosis of the udder. In 1913, however, we encountered two cases that we thought, perhaps without sufficient reason, to be the result of infection by the blood stream, and the animals were still in moderate condition of body when condemned under the Tuberculosis Order. Both animals were heifers, one a virgin the other in calf and two months from her calving date. In both cases the whole udder was uniformly hardened and tuberculous. The in-calf heifer was detected during herd inspection. Though rather spare of flesh, her health was not suspected by the owner, as she fed well and had a good coat. The udder was found to be uniformly hard as a board throughout, and so even of its surface and beautifully shaped, with teats properly set, that it was considered almost perfect from an exhibitor's point of view. Indeed the heifer had been sold the day before our visit, and was expected by the buyer to be first in her class at a forthcoming show. The size of her udder was like that of an animal due to calve, but there was no œdema or pain on palpation. The post-mortem in this case and that of the virgin heifer revealed old lesions of tuberculosis in the lungs and on the pleuræ and peritoneum. The supra-mammary glands were enlarged, and, though slightly tubercular, we thought their infection was secondary to that of the udder.

(*b*) *By the Lymph Stream.*—This is doubtless the chief route of infection, although it is against the flow of the lymph stream, but M'Fadyean says it has been experimentally proved that infection extends in both directions when subcutaneous inoculations are made. His irrefutable arguments against the theory of infection by the blood stream in all but the most exceptional of cases serve to establish centrifugal infection through the lymphatics as the chief route.

(*c*) *By the Teat Canal.*—Primary infection of the udder by the teat canal is undoubtedly rare. M'Fadyean considers it probable, since it is the common venue of other infections of the gland, but states that he has only seen one case in which he was satisfied the disease began at the lower part of the udder. In Hoare's *System of Veterinary Medicine*, vol. i. p. 393, we state that we frequently encountered the tuberculous lesion just behind the teat, causing the quarter to sag, or immediately in front of it, extending backwards over its base. If some of these well-defined low-lying tumours are primary infections, and if it be possible that human tubercle bacilli of virulent type can find a lodgment in bovine tissues (consumptive milkers are not unknown), a new significance is attached to the use of the milk secreted by the quarter, since bacilli of human type are more potent than bovine to induce progressive and fatal tuberculosis in the human consumer. Tuberculosis of the udder in bovines is essentially a disease of aged animals, but we have met with it three times in virgin heifers and occasionally in three- and four-year-olds. Our records in Lanarkshire for several years, and including the fifteen months' operation of the Tuberculosis Order, show that mammary tuberculosis was detectable in 3 per 1000 animals without the use of the tuberculin test, a positive reaction to which, in our view, is no proof that an indurated udder is the seat of tuberculosis.

Symptoms.—In 90 per cent of cases only one quarter is affected, and that a hind one in 9 out of every 10 cases, and the usual seat of the lesion is the upper third of the quarter. Occasionally, as already explained, it is lower down in front of or behind the teat, and in extremely rare cases there is a simultaneous hardening of all four quarters. There is no history of mammitis or injury, and the growth of the tumour is very insidious. The lesion is usually single, hard, fibrous, and painless, with well-defined irregular borders, and there is no adherence to the udder integument. It varies much in size and sometimes grows very quickly. In most cases it feels like a crudely-shaped piece of vulcanized rubber lying in the softer tissue of the gland. The appearance of the secretion is at first unaltered, and its amount only gradually decreases. It soon becomes poorer in fat and sugar and is very like whey. It never contains pus or clotted material, though, when centrifuged, it shows a plentiful greyish deposit. Later on, and especially in animals that are dry, the product of the quarter is of a characteristic canary-yellow colour. The tuberculous quarter of a dry cow always contains some fluid. It has been found possible to detect tubercle bacilli microscopically in 95 per cent of samples taken from affected quarters, and when acid-fast bacilli are got in a properly taken sample of milk, direct from the udder, the existence of udder tuberculosis may be asserted with confidence. It is generally held that the last milk or strippings taken from an affected quarter contains the greatest number of bacilli, but careful tests made in the county of Lanark laboratory showed that they were most plentiful in middle milk.[1] Milk containing tubercle bacilli is eminently dangerous. It readily begets disease in young animals, in children, and in older people suffering from disease of the digestive organs who are largely fed on milk. Many observers have shown that the great majority of cases of cervical tuberculosis in children are dependent on bacilli of bovine type, and we have met with three cases of tuberculosis of the vertebræ in stallions which were fed on cow's milk, when they were colts, to increase their growth and condition.

Structural Changes.—The nature of the lesion in its early stages is not well known. When a quarter containing a recently-developed lesion is incised the diseased part has a fibrous, firm feeling, and this is seen to be due to increase in the interlobular tissue. Of a greyish colour, the cut surface varies in appearance with the age of the lesion, and the diseased tissue appears to merge more gradually into the healthy than is betrayed by the feel of the lesion in the live animal. Older lesions, on section, show evidence of caseation and necrosis, and the cut surface, instead of being smooth, is studded over with innumerable nodules of a yellowish-grey colour, resembling grains of sago. For a description of the microscopical appearances of the diseased tissue and its morbid histology the reader is referred to M'Fadyean's article mentioned above.

Increase in Bulk (Progressive Metamorphoses) of the Mammary Gland.—Increase in the size of the mammæ may be due to hypertrophy or the existence of tumours.

(*a*) *Hypertrophy.*—The increased growth of the mammæ associated with lactation is a natural condition. But we have already shown that excessive growth of a physiological character is occasionally seen in non-pregnant animals, and can be induced to some extent by stimulating the mammæ or applying a young animal to the teat, when even the secretion of milk may occur. We have repeatedly observed uniform hypertrophy of the whole of the bovine udder, causing the organ to sag to such a degree that the teats reached near to the ground and the milk had to be drawn off into a shallow vessel placed on the ground. In these cases the enlarged and heavy organ seems to have broken away from its attachments, for the udder-tissue is no longer in intimate contact with the trunk, and a distinct compressible neck is formed. Œdematous swelling is usually excessive at the time of parturition, and, owing to defective circulation in the pendulous organ, it is slow to undergo absorption and materially adds to the hugeness of the udder. The animal seeks relief in the recumbent position. The cause of this condition is obscure, but it may be associated with some disorder of the genital functions. In most cases the udder has a hardish fibrous feel due to increase in its connective tissue elements, and, though the milk secreted may be normal in quantity and quality, its removal does not materially lessen the bulk of the organ. The application of a many-tailed suspensory bandage tied over the back of the cow affords marked relief, and the udder should be unloaded at least four times a day, and the animal should occupy a double stall and have a good bed.

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[1] Hoare's *System of Veterinary Medicine*, vol. i.

Compensatory hypertrophy is not uncommon in the remaining healthy quarters of an udder that has lost one or two of its sections as a result of past mammitis, and Ribbert has experimentally shown in animals that removal of one-half of the mammary gland is followed by hypertrophy of the remainder.

(*b*) *Tumours of the Mammæ.*—If we except the vegetative warts or papillomata that are so commonly met with on the teats and udder integument of young bovine stock, it must be conceded that mammary tumours are exceedingly rare in the larger domesticated animals. Their rarity in the cow is surprising when we consider the constant unrest, anatomical and physiological, to which her udder is subject, but it is to be recollected that stock-owners habitually prepare the cow for slaughter that shows a defect in her udder. Our knowledge of mammary tumours in the lower animals is almost entirely based on our experience of them as met with in bitches. In them it would appear that the natural balance of things was more easily upset under the stress of the irritation that accompanies different grades of inflammatory action. And it is very often a difficult matter to differentiate between the neoplastic overgrowth that so often follows inflammatory irritation and true tumour formation. The causes of tumour growth in the mammæ are obscure, but the structure of the new tissue, whether benign or malignant, bears a distinct relation to one or other of the elemental types of tissue of which the mammæ are composed, viz.: skin, fibrous stroma, and glandular tissue. Mixed growths are not uncommon, for the fibrous and glandular tissues of the organ often undergo simultaneous proliferation, resulting in much variety of tumour formation, but epithelial tumours are invariably true to type.

Cow—Warts on the Udder (Papillomata).—These outgrowths are almost entirely confined to young animals, are caused by irritation, and have a tendency to disappear with age. They do not return when surgically removed. By some authors they are ascribed to a definite infective origin, and in the human subject clear evidence has been brought forward of the transmissibility of papillomata by implantation or infection.[1] There is also some proof of their transmission from the cow to man. Whether the irritation that gives rise to warts is of bacterial origin has yet to be determined. Three distinct types occur on the udders of cattle, viz.: globular, flat, and cylindrical.

(*a*) **Globular warts** are peculiar to cattle. They appear as whitish or yellowish tumours, flatly globular or oval in shape, and attached to the teat, or the skin of the udder near the teat, by a narrow neck, or are loosely embedded in the skin.

They vary in size and occasionally measure from 1 to 2 inches, though most of them are smaller. They are easily enucleated from their epithelial or horny covering, and this often happens during removal by hand, and when cut into the exposed surface shows a bulging mass of greyish-white fibrous tissue.

(*b*) **Flat warts,** also peculiar to cattle, are yellowish-white in appearance, and are usually attached to the teat by a thin pedicle, though sometimes they appear as a scale-like thickening of the epidermis.

(*c*) **Cylindrical Warts.**—These are the ordinary variety of warts—an outgrowth of a collection of papillæ of the corium—pointed and covered by a common, thickened, and somewhat hypertrophied horny epiderm, the free ends being darker in colour. Single ones appear as tapering, thorn-like growths, but they are often conglomerate and appear as brush-like outgrowths. They are markedly vascular and intimately attached to the skin. In some instances they are so numerous that the teat is almost entirely hidden by them.

Treatment.—Affected animals should be isolated. Removal of the warts should be practised early so that the teats may be healed before calving time. If this be neglected in the case of cylindrical warts they give rise to much trouble during the process of milking. Globular pedunculated forms are easily pulled off by hand, and the resulting bleeding is insignificant. For the proper removal of flat and cylindrical warts it is often necessary to cast the animal, and with a pair of scissors the warts are snipped off at their base. The bleeding surface is then dressed with an astringent and antiseptic solution, and later with an emollient ointment or liniment. Deeply-rooted warts should not be forcibly pulled off or a fistula of the teat may result. None of the papillomata recur after removal.

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[1] Jadassohn, *Verhandl. d. deutsch. dermatolog. Kongr.*, 1898.

Other kinds of tumour of the bovine mammæ are almost unknown. Reference has already been made to intra-canalicular warts that cause stasis of the teat.

Mare.—Equine mammary tumours are as rare as bovine, and the teats of the mare, unlike those of the cow, are not subject to verrucose papillomata. We believe that most of the so-called tumours of the mare's udder are due to botryomycotic infection, and those resembling adenofibromata are perhaps the result of simple inflammatory induration.

Bitch.—Neoplasms, innocent and malignant, are commonly met with in the mammæ of the bitch. Benign or innocent growths consist of fibromata, adenomata, lipomata, myxomata, and chondromata, or a mixture of these varieties. They are painless and of slow limited growth. Malignant tumours include sarcomata, carcinomata, and epitheliomata. They are painful, cause emaciation, grow rapidly, and often involve the neighbouring lymphatics or ulcerate, and they readily become generalized.

Fibromata.—This common form of mammary tumour is composed of fibrous tissue. They are usually discrete and encapsuled, smooth and firmly elastic, and greyish-white on section. Softer forms of fibromata are due to transformation into myxo-fibromata.

Adenomata consist of retrograde gland structure and are not common. Fibro-adenomata—a mixture of connective tissue and gland elements—are more common. In these, cysts which contain a yellowish fluid occasionally occur.

Lipomata.—Fatty tumours are usually seen in plethoric animals in the subcutaneous tissue, outside the gland, and are caused by oft-repeated bruising of the mammæ. They are smooth, round, soft, and discrete, and the cut surface is white and oily or lardaceous.

Myxomata are rarely met with as pure tumours of the mammæ—without admixture of glandular elements. Mucinous transformation of fibromata and sarcomata is not uncommon.

Chondromata.—Cartilaginous tumours and osteomata or bony tumours are common in the bitch. They occur as pure growths or may be associated with fibrous tissue or with sarcomata or carcinomata. Care is necessary to avoid mistaking cysts with calcified walls for these tumours.

Cartilaginous and bony tumours are easily diagnosed on account of their hard consistence. They are of slow growth, discrete, unattached to the skin, lobulated, and easy to enucleate.

Sarcomata are malignant connective-tissue tumours, and though they sometimes occur in pure form they are usually associated with cartilaginous and osseous structure, and occasionally with cyst formation. Their consistence, therefore, is variable. They are often very large, have a round contour, and the mass shows many rounded outgrowths that invade the neighbouring tissues. They develop quickly, are metastatic, and the neighbouring lymphatics are usually infiltrated. In some cases they are unattached to the skin—in others the skin is broken and the tumour is ulcerated. Sarcomata may have a history of traumatism.

Carcinomata may originate as true primary growths, but this is rare. They are more often produced by the transformation of fibrous and adenomatous tumours into cancer growths. A certain percentage of cases are traumatic in origin. The carcinomas are hard and knotty; they vary much in size and usually coalesce with the skin, giving the latter a reddish-blue appearance, and granulating ulceration eventually occurs. More than one gland may be involved, and the tumours are never encapsuled. The knotty surface of the tumour shows rounded outgrowths from the margin, and its hard substance gives an impression of weight, and, when cut into, a colostral-looking fluid exudes, the exposed surface being grey-white in colour. Some cases of the scirrhous type run a chronic course, but metastasis to vital centres is the rule.

Epitheliomata are derived from the epithelium of the ducts and acini which proliferate to form new growths. Opinions vary regarding the frequency of their occurrence in the mammæ of the bitch. The surface of epitheliomas is lobulated, and in many respects they resemble carcinomas and adenomas. The interior of the tumour is yellowish-white and some fluid escapes when it is cut into.

Treatment.—All tumours of the mammæ should be removed by early operation, and as the parts are very vascular precautions must be taken to avoid undue bleeding. The results are usually good when the tumour is discrete or encapsulated, but if there be marked evidence of malignancy, as shown by infiltration of the tissue around the tumour and local metastasis, the prognosis is bad, and recurrence of the growth is to be expected. If cachexia be present, the patient should be destroyed. We know of no internal treatment that can influence the growth of the tumours referred to.

MILKING-MACHINES

The milking of cows by mechanical means has engrossed much attention for many years, and the makers of these machines that have proved their utility should find their opportunity for the more extensive use of their apparatus in the growing difficulty of dairymen to find good hand-milkers. Almost without exception the machines of to-day work by intermittent suction, in imitation of the sucking calf. The earliest attempt at mechanical milking was by means of teat-tubes or syphons, but this was doomed to failure by reason of the attendant risk of udder infection when instruments of any kind are introduced into the teats. Machines that operated by "mechanical pressure" were next tried and were more or less successful, but they have now been almost entirely superseded by suction machines. The first-used suction machines did their work by "continuous" suction and were not satisfactory. Their defect was got over by adapting pulsators to the apparatus which, by interrupting the vacuum, make the suction intermittent. The number of pulsators and the nature of the pulsating arrangement vary in the different types of machines in use to-day. With the exception of the "Amo," which is a single-cow machine suspended below the udder by straps of webbing, the whole apparatus, including the milk-receiving pail, rests on the ground and may be single or double. In the latter case two cows in the same stall are milked simultaneously, and they should be of about the same milking capacity. The necessary power is provided by means of water, oil or petrol engine, steam or steam ejector, electricity or gas, and is in most cases transmitted to the cow-shed by means of metal pipes running the length of the building above the heads of the cows. In each stall a single or double stopcock is attached to the pipe, to which the free end of a rubber tube from the milking-machine is attached. The teat-cups, of aluminium, brass, or gun-metal, are usually lined with rubber, and when the power is turned on at the overhead stopcock and the cups are held to the teats they virtually jump into position. In this country there are at least seven types of suction machines that have found favour, viz.: The Wallace, the Lawrence-Kennedy, the Lister, the Amo, the Amanco, the Vaccar, and the Gane.

The Wallace is a single-cow machine, and has a pleasing simplicity of appearance. Instead of a master pulsator it has a special pulsator for each teat-cup (four in all). Unlike the Lister and Lawrence-Kennedy, it has no glass tube arrangement at the top of the milk reservoir, so that one cannot tell by sight when the cow is finished, but the lead disc below is warm when milk is passing and gets colder when it ceases. When the cups are removed after milking, the teats have a square appearance and feel solid, but no bad effects are recorded from this circumstance. When tested the Wallace took fully eight minutes to milk a cow, yielding 19½ lbs., or nearly 2 gallons of milk. The Wallace was installed at the Crichton Institute, Dumfries, in 1908 at a cost of fully £1 : 10s. per cow and has given much satisfaction. With 6 machines the operator can milk 69 cows in 1½ to 1¾ hours with the help of two assistants. The 6 machines are cleansed in a few minutes at night with cold water only summer and winter, but after the morning milking both cold and hot water are used. The power-pressure is kept at 15 lbs. on the gauge and an average of 1 lb. of milk is got from each cow by hand-stripping after the machine is removed.

The Lawrence-Kennedy (Burrell).—This is a single-tube machine, and its metal funnel-shaped cups have no lining of rubber but only a rubber mouthpiece, and a single suction-tube connects the cups to the milk receptacle. This machine is a favourite at Mr. Cross's, of Knockdon, Ayrshire, where it has been in use for about ten years. The machines do best when working at the rate of 52 pulsations per minute, and milking is not expedited by faster pulsation. Mr. Cross finds that a 3½-h.p. engine is not too strong when 10 cows are being milked simultaneously. Two cows in full flow were milked by a double-machine in twelve minutes.

The Lister.—Single and double machines of this make are supplied. Unlike the Wallace and Lawrence-Kennedy, the Lister has two rubber tubes instead of one to the cups, and though this entails additional upkeep it is claimed that the special air-tube entirely prevents contamination of the milk-tube with lubricating oil, etc. Though the double Lister machine works satisfactorily, the makers recommend their single one because it is not always easy to grade in pairs cows of equal milk-yielding capacity. A double Lister milked two cows, yielding jointly 6 gallons, in 7 minutes, and other two in 6½ minutes that gave 5 gallons. At Hartwood Asylum, Lanarkshire, 70 cows are milked and hand-stripped in 75 minutes, the 5 machines in use being handled by 5 women. At Mr. Nairn's, Hazlebrae, Lochmaben, 3 operators, handling 1 double and 4 single machines, milked 49 cows in 80 minutes, and a petrol engine of 1½ h.p. gives sufficient power for the milking of 6 cows simultaneously. During the first ten months less than £1 was spent in renewing rubbers. It is stated that slow pulsation (less than 60 per minute) suits best for cows that are stiff to milk.

The Amo.—This is a single machine made in Sweden, and the whole apparatus, including the milk reservoir, is cow-borne, being suspended below the abdomen by means of straps of webbing. The milk-tubes are of celluloid, and are transparent, easy to clean, and last well. In the hands of an expert the Amo is easy to apply, but a good length of reach is necessary to place it in position and adjust the cups to the teats. If the cup becomes detached it does not fall to the ground. Four small weights of about 6 oz. each are hung on the apparatus, one below each teat, to lessen the upward pressure of the cups on the udder. The Amo is a suitable machine for a small herd. Hand-stripping of 12 cows milked by it produced 6 lbs. of milk.

The Amanco, or **Hynman-Amanco.**—This single-cow machine differs from those already described in its pulsating mechanism. The engine-power is conveyed to a pulley with a crank-shaft, and from this a to-and-fro motion is given to a wooden shaft that runs the length of the byre and is suspended to a beam by eyelets, which are kept well greased. The movement of this shaft operates the plunger of a small brass pump fixed to a beam above each cow, and the alternate suction and compression produced is transmitted by a flexible tube to the valve chamber on the top of the milk receptacle. The cups used are the same as those of the Lawrence-Kennedy, and the udder unit is provided with a hook by means of which, in the case of a three-teated cow, one of the cups can be hung up and suction to it cut off. Mr. Retson, Kirkfieldbank, Lanark, has found the Hynman-Amanco a cheap, effective, and economical machine for the milking of 20 cows, and says it operates best at 51 strokes per minute.

The Vaccar is in many respects like the Lister, being a double-tube machine.

The Gane.—The special feature of this machine, which is made in New Zealand, is that it is not provided with a pulsator for each machine but has a single one fixed overhead that does duty for a byre of average size. It is a double-tube machine, and the greater part of the tube between the stopcock and the machine is of nickelled metal, the ends only being of rubber.

Hand-stripping.—This is customary in the majority of herds milked by machine, and an average quantity of 2 lbs. of milk is got from each cow. The amount varies in different animals, and is least in those that have been long used to machine-milking, and in cows at the height of lactation. In herds where stripping is not practised as a precaution, the owners state that the ultimate weekly or monthly yield of milk is not appreciably affected thereby. They hold that habitual stripping encourages the cow to master the machine when the udder is nearly empty, and the need for stripping is thereby accentuated. Stripping should always be done if there is reason to believe the machines have been operating defectively.

General Remarks.—Milking by machines has passed beyond the experimental stage, and, while it is a difficult matter to choose the best among so many reliable types, it is easy to find among users advocates for every make. Indeed it is exceptional to find a dairyman who will go back on his own choice or admit that for his own special herd it is inferior to any other. Success or failure depends much more on the individual than the machine. The proper cleansing of the apparatus will not suffer neglect, and there should always be one intelligent and interested individual at hand to supervise and to attend to any break-down that may take place. The different makes vary within narrow limits in initial cost, upkeep, speed in milking, suitability for different sized herds and premises, in the amount of labour necessary for cleansing, and in the need for hand-stripping after the machine, but without exception all of them attain practical success when properly operated and kept in order. The great majority of cows take kindly to the milking-machine in spite of the noise caused by the pulsators, and many tender-teated animals which are restless to hand-milking stand quietly to the machine. With cows that are extremely nervous and given to kicking and spilling the milk it is judicious to make the best of them by hand-milking. The machine excels in milking heifers with swollen udders and short, tender teats—animals that try the patience of the hand-milker. We are sceptical of reports to the effect that cows are milked by machines in four to five minutes. Even with skilled operators many take almost double that time, but as a rule the machine should be removed after ten minutes even though it is thought the udder is not quite empty, for by that time the cow has mastered the machine and yields no more to it. Newly-calved cows should be milked by hand for three or four days until the milk is normal in appearance; if the machine is used from the beginning, a special set of cups and receptacle should be set apart for this purpose. If a cup falls from a teat at any time all the cups should be removed, the teats hand-stripped a few times, and the cups reapplied. The cleansing of milking-machines is all-important, not only to prevent tainting of the produce, but to reduce the tendency of the rubber parts to perish. Experts are agreed that it is essential to disconnect, examine, and thoroughly cleanse every part of the machine once in seven days. After each milking on the other days it is sufficient to wash the milk-soiled parts with lukewarm and then hot water, after which the rubber tubes and the cups are left to steep until required again in a solution of inodorous antiseptic, such as formalin 1 in 100–150 of water. The washing process is usually accomplished by suction. All udders should be swabbed with a clean wet cloth before milking is begun.

The chief advantages that attend the use of a reliable milking-machine are as follows :

(1) Diseases of the udder and teats are quite exceptional. This is due to the fact that a supervisor can easily make sure that all teat-cups are clean, though he cannot so readily control the condition of the hands of careless milkers.

(2) The milk is clean and wholesome and therefore keeps well, and if manufactured into butter and cheese these should be of first quality. Unlike hand-milking, the use of the machine exposes the warm milk to a minimum of atmospheric contamination, and there should be an entire absence of the filth and skin debris that so readily reach the open pail during hand-milking.

(3) The owner of a milking-machine is more or less relieved from the vagaries of the labour market, and in many cases it enables him to conduct his business with a lessened staff.

Abnormal Milk.—Pure milk is acknowledged to be the most perfect of all food-stuffs, since it contains all the elements necessary for the support of life. But its purity is unstable, for though it may be sterile when drawn from the udder, changes at once begin in it which are due to micro-organisms that gain entrance to it from many sources. These bacteria find in milk a suitable medium for their growth, especially when the milk is warm or is kept in a warm atmosphere. The refrigeration of newly-drawn milk—so commonly practised in warm weather—inhibits bacterial development and lengthens the period during which the milk remains sweet and fit for use in a raw state. Bacterial growth practically ceases if the milk be cooled to near 40° F., though the bacteria are not actually killed. But if milk has been exposed to contamination for some time its period of sweetness can only be materially lengthened by artificially raising its temperature to 140°–165° F., which kills the great majority of the bacteria. A longer exposure is necessary at the lower than at the higher temperature, and the milk so treated should be at once refrigerated. It will be seen that the most important changes that take place in milk are due to microbes. The bacterial flora of exposed milk comprises many species, the most important being the lactic bacteria, which are so common that they may be considered as normal constituents. They usually preponderate over the putrefactive organisms present, and by changing the milk lactose into lactic and carbonic acids they produce a medium that is inimical to the growth of putrefactive organisms. Occasionally, however, the contamination by microbes of putrefaction is so gross that they gain supremacy to a greater or lesser degree, with the result that the milk acquires an odour and flavour that are objectionable, and these "milk faults" are maintained through the process of manufacture into butter and cheese, rendering them inferior in quality.

Clotting or Curdling Milk.—This is one of the commonest of milk faults. It usually appears very soon after the milk is withdrawn from the udder, and in a few hours the milk is curdled into a cheesy condition. It is usually due to a preponderance of some of the lactic ferments, which may have been derived from the udder itself or the atmosphere, or may have been present in the milk-receiving vessels. There is also reason to believe that disorders of the digestive organs caused by soured food, as well as electrical conditions of the atmosphere and bad ventilation in the cow-shed, result in the production of milk that is peculiarly suitable to the growth of lactic ferments. Milk that is about to curdle in this way always gives a poor return in butter and is difficult to churn.

Treatment.—Faults that are suspected in the food, ventilation, or the dairy utensils should be removed at once. Disorders of the digestive organs or the udder demand special treatment, and with a view to producing an alkaline state of the milk 1-ounce doses of bicarbonate of soda may be given to each cow twice daily, two hours before the milking periods, or a teaspoonful of the bicarbonate dissolved in 2 ounces of warm water may be added to every 8 gallons of newly-drawn milk.

Milk producing little Butter.—It is characteristic of milk with this fault that the cream does not rise well. The causes of the defect are ill understood, but are considered to be bacterial. Though often associated with putrescence or rancidity, the non-buttering defect sometimes exists in milk deficient in fat that possesses no unpleasant odour. Instead of rising in a solid uniform layer the fat appears as greasy-looking globules on the top of the milk.

Treatment.—All dairy utensils should be cleansed and disinfected, and the affected milk should be centrifugalized. Galactogogues are to be recommended : aniseed, caraway seed, antimony, fennel, vinegar and water, and hydrochloric acid and water.

Putrid Milk.—Milk of this quality is usually produced in insanitary byres, where the milk is subject to gross contamination. But on occasion this milk fault appears in up-to-date premises, and is baffling to get rid of because of the difficulty in determining the source of the putrefactive organisms to which it is due. In such an outbreak we found that out of thirty-two cows only fourteen yielded milk that turned bad, and on certain days the produce of some of these remained sweet for a normal period of time, and on further analysis it was found that the milk from one or two quarters in some of the indicted cows kept good while that from the remaining quarters became putrid. The fault prevailed more or less for fourteen days in spite of every precaution, and gradually disappeared, to reappear again in a lesser degree three months later when the cows were on grass. The milk usually remained sweet for six or more hours after it was drawn from the cows, and on occasion kept sweet for twelve hours, when it would very quickly become dirty-coloured and evil-smelling. There was no evidence of ill-health in the cows, and the milk taken from the three healthy quarters of the only cow suffering from mammitis was never affected. No use could be made of milk after it had turned, but, with the exception of what was kept for testing purposes, the produce was salved, until the fault disappeared, by heating and cooling it. The diseased milk contained many different species of putrefactive organisms, and, while in all cases it was of a dirty colour and had a repulsive odour, it sometimes assumed a bluish tinge. Bubbles of gas were so plentiful in some samples that they seemed to be effervescent. The origin of this outbreak remained obscure.

Treatment.—This must comprise complete disinfection of the whole premises, dairy utensils, cows' udders, and the hands of milkers, who should be supplied with clean overalls. The water-supply should be seen to, and every drop of water used for the utensils should be boiled if there is any reason to suspect the purity of the supply.

Bitter Milk.—When this fault appears in a dairy it is very difficult to get rid of, and if the produce of the dairy be consumed within a few hours after it has been drawn from the cow the anomaly escapes detection for a time. The appearance of the fault is more quickly detected when the milk or the cream taken from it is made into butter. Defective rations and irregularity of diet have been blamed, but in the bitter cream the existence of organisms has been proved that have the power of rendering milk bitter experimentally. This subject has been much studied on the Continent, and the following organisms have been indicted, viz.: Weismann's bacillus of bitter milk, the bacillus of Bleisch, Conn's micrococcus, the tyrothrix of Duclaux, the *Torula amara* of Harrison, etc. These and other organisms have been also isolated from bitter cheese, and it is thought the bitterness in the different products is due to the peptonizing faculty of the causal agents. The question demands further research and experimentation, as the fault is a very tenacious one and often defies, for some months, the efforts that are made to get rid of it.

Soapy Milk.—This name is given to milk that has a soapy taste, which is caused by the *Bacillus saponacei* of Weismann and Zirn. This organism is said to be present in the fodder, and the milk becomes contaminated when the hay or straw is disturbed during the milking period. The milk never coagulates but becomes soapy in taste, has a slimy deposit, and yields a frothy cream from which butter is made with difficulty.

Ropy or Viscous Milk.—These terms are applied to milk that becomes thick, sticky, and thready, and the fault is seldom seen until after twenty-four hours. Little cream is produced, and the butter made from it is of bad flavour. Although the milk curdles badly in a true sense, it pours from the jug containing it reluctantly, the cream on the top has a tough appearance and normal colour, and the mucilaginous mass below it is of a beautiful shiny-white colour and is almost tasteless. It is a common fault in insanitary cow-sheds, and various micro-organisms have been proved capable of producing this mucilaginous change in milk. These include the *Bacillus viscosus* of Adametz, the bacillus of Loeffler, the micrococcus of Hüppe, the bacillus of Guillebeau, etc. The fault is often proved in herds where mammitis prevails, and is traceable to contamination of the milk with the diseased products of infected udders. Recent investigations have differentiated between the slimy and the stringy faults in milk, but it cannot be doubted that they are often coexistent.

Treatment comprises thorough sanitary measures in the byre and dairy. The milk can be salved by sterilization.

Red Milk.—We do not here refer to the red coloration of newly-drawn milk so commonly met with in some cows for a few days after calving, and which is due to the presence of blood in the milk. When such milk is allowed to stand the red blood corpuscles are deposited to the bottom of the vessel, and a thin red film is seen when the milk is poured out. The red milk fault referred to only appears after a period when the organisms that give rise to it have had time to multiply sufficiently. The organisms that are known to produce the red tint in milk include the *Bacillus prodigiosus*, which colours chiefly the top layer of the milk, the *Bacillus lactis erythrogenes*, which tints the milk throughout but is not effective if the dairy is well lighted, and two species of sarcina.

Treatment.—The fault readily yields to thorough methods of cleanliness in the cow-shed and dairy.

Blue Milk.—This milk fault is seldom seen before the second or third day. It is caused by the *Bacillus cyanogenus*. The earliest signs of the fault consists of small patches of a bluish colour on the surface of the milk, which gradually enlarge to produce a uniform blue tint that by and by permeates the whole mass. It has been shown that the *Bacillus cyanogenus* produces a grey instead of a blue colour in sterile milk, and that to cause the blue coloration the bacillus requires the association to some extent of the ordinary lactic ferments of milk. A temperature of 140°–150° F. is sufficient to destroy the bacillus.

Yellow Milk.—A natural yellow tint in ordinary milk is characteristic of certain breeds of cows, *e.g.* Jerseys, and is valued alike in the milk and the butter made from it. But the diseased condition known as yellow milk is due to the *Bacterium syxanthum* of Ehrenberg and Schröter, which produces a lemon-yellow coloration of the milk, curdles it, and after some days liquefies it. It is held that boiled milk only is liable to this infection, so that the fault is of little practical importance.

H. B.

APPLIED OBSTETRICS

Introduction.—Parturition difficulties naturally occupy a prominent place. It is well known that many valuable breeding animals are annually sacrificed for want of a little knowledge and initiative in correcting wrong presentations and positions of the fœtus, or deviations of its extremities. For example, a fore leg flexed or turned back at the knee is easily straightened, as a rule, in the early stages of labour; at a later stage the deviation may be difficult or impossible to set right without serious injury to dam or offspring. Nevertheless our aim is not to provide a compendium of first-aid treatment or to set forth anything new, but to indicate in plain language the measures required to bring about successful parturition, and, with a view to prevention, to discuss the causes of the various accidents and diseases connected with birth. Broadly speaking, obstetrics is the study of the dangers and diseases occurring in the process of reproduction, commencing with the period before conception, and ending with the diseases of the very young animal. But a restricted, or less comprehensive, meaning is often attached to the word. Thus obstetrics commonly means the study of parturition difficulties and how to overcome them, including the accidents and diseases incidental to or following the act, but especially those connected with difficult labour. The principal obstetrical operations also claim consideration. We use the term "Applied Obstetrics" in this sense. Difficult birth, or *dystocia*, occurs whenever assistance is required to effect delivery. It may depend either upon the mother or the fœtus, but the latter is generally at fault in the lower animals. Hence in dealing with difficult birth we shall confine our remarks to fœtal dystocia.

Applied obstetrics is considered under the following heads:

1. Parturition difficulties.
2. Inversion of the uterus, vagina, and bladder.
3. Retention of the afterbirth.
4. Metritis.
5. Post-partum hæmorrhage and rupture of uterus.
6. Sterility.

1. Parturition Difficulties in the Larger Animals (Mare and Cow).—It is generally admitted that dystocia is more frequent in the cow than mare, notwithstanding the fact that in most districts more cows are bred than mares. The incidence of dystocia is increased by domestication and an intensive system of management. Thus the chief sufferers are dairy cows which are tied up most of the year, while pedigreed and other cows which enjoy plenty of freedom, and other species which lead a natural life in the open, are less often affected. The influence of confinement is well seen in pampered brood mares and in pet dogs, especially toys. Under a rational system of management these animals suffer to a much less extent from difficult labour. Among all the domesticated animals dystocia is of most importance in the mare, both in regard to the recovery of the mother and the life of the foal. The reasons for this are both maternal and fœtal—maternal, because the mare's labour pains are always violent, birth is rapid, and the mare is most susceptible to infection; fœtal, because the long limbs and neck of the foal, especially in thoroughbreds, are more difficult to adjust, and therefore more liable to injure the dam. Again, dystocia in the mare generally means a dead fœtus; whereas the calf is born alive, in spite of the fact that delivery may take several hours. This dissimilarity in the foal and calf is largely accounted for by the differences in the placental attachment (see "Retention of the Afterbirth"). The membranes in the mare rapidly separate from the uterus; and the foal, deprived of the oxygen circulating in the mother's blood, soon becomes suffocated. Furthermore, the fœtal circulation is seriously interfered with by the mare's powerful expulsive efforts, which bring pressure to bear on the umbilical cord. In any animal, birth must be quickly effected as soon as the cord is compressed or ruptured, if the life of the offspring is to be saved. The violent straining of the mare also hinders the passage of the hand between the fœtus and the uterine wall, and renders manipulation much more difficult. These facts being fully known and widely recognized, we arrive at the simple conclusion that the greater and more prolonged the straining the worse the dystocia becomes and the more the difficulties of the operator are increased. Given the same malpresentation, or deviation of limb or head, the mare, all force and violence, will soon render delivery of the intact fœtus impossible, or force it out in a wrong position, and endanger her own life; whereas the cow, more patient and tractable, will stand a delay of six hours with impunity. Notwithstanding these serious impediments to successful parturition, the mare has the advantage over the cow in three respects: (1) the long, narrow head of the foal occupies less room, and is thus more easily delivered; (2) the standing position generally assumed by the mare proves of assistance to the operator; (3) it is but seldom that mares require help during labour, although, when it is needed, it must be given quickly. Experience teaches many useful and much-needed lessons, but none more important than the danger of delay in securing skilled assistance. For not merely is a simple deviation of an extremity (turning back of the head or a limb) greatly aggravated, but the lives of fœtus and dam are jeopardized, while, in the event of recovery, the latter may prove to be sterile (see "Prevention and Treatment of Sterility"). Again, a dead fœtus in an improper position is less easily extracted for the reason that contractions of the uterus fail to set up spontaneous movements in a dead doubled-up fœtus. These movements in the live animal tend to extend and straighten the limbs and head. Delay also increases the chances of infection by leading to the exhaustion of the mother. The owner, therefore, no less than the expert, is directly concerned in relieving the mare of the foal at the earliest possible moment. He should *send for the veterinary surgeon at once in every case of difficult labour in the mare.* This advice need not deter him from rendering first aid, as far as circumstances permit, on the lines indicated hereafter.

Natural Presentations and Labour.—Occasionally the various domesticated animals require aid in parturition, even in natural presentations, when the labour pains are weak and the work of expulsion does not proceed; yet undue or improper interference is to be deprecated. In such cases the attendant should not hesitate to make an internal examination, provided he exercises every care, pares and files his finger-nails, washes and disinfects his hands and arms, and makes use of a lubricant such as fresh lard or butter, olive oil, vaseline, or even soap, if nothing else can be obtained. The hind parts of the animal should also be washed and disinfected, while the box or stall should be clean, dry, and well bedded with fresh straw. The hand should be introduced during an interval in the straining with the fingers extended in the form of a cone, care being taken not to press against the dam. These precautions are necessary in order to prevent infection and its results (see "Metritis" and "Retention of Afterbirth"); and no harm can ensue if they are properly observed. The manual examination will ascertain whether the fœtus is coming naturally and the "os" (neck of womb) fully dilated. If so, it is advisable to wait a while, especially in heifers, meantime making the animal as comfortable as possible. A good deal depends upon the *water bladder*, which, by mechanically opening up the passage, prepares a way for the fœtus. The bladder consists of the fœtal membranes distended with fluid, and makes its appearance at the vulva during the throes at an early stage of labour. Being transparent, the nose and fore feet of the fœtus are sometimes seen through it. Soon the water bladder ruptures spontaneously (it should never be interfered with in ordinary births), and the "natural waters" are expelled. Sufficient fluid, however, remains in the uterus to be pressed out at each pain. In addition to its function as a dilator, the fluid acts as a natural lubricant in facilitating birth, besides preserving equable pressure on the fœtus and preventing the womb contracting too tightly upon it. But these valuable effects disappear when labour has been prolonged and the reserve fluid expended, so that the maternal parts become dry and contracted. The time of rupture varies, but it should be noted in every parturition. With the mare rupture may be delayed until the foal is born imprisoned in the intact membranes. In this way several foals are annually lost owing to no one being at hand to set them free. The young animal generally presents longitudinally in an upright position, with the fore limbs, head and neck extended in a straight line, and the nose resting upon the pasterns or fetlocks. This arrangement enables it to occupy the least possible space in order that it may pass through the fixed bony inlet of the maternal pelvis. Occasionally the fœtus presents posteriorly with hind legs in the passage. This occurs more often in twins, one of which may come head first, the other tail first. In both presentations it should be remembered that there is little room to spare; any departure from the normal, either in the position of the fœtal body or in the arrangement of its limbs, readily causes dystocia. It is clear that unless the young animal is coming longitudinally in line with the pelvis and passage of the dam, and with its head and limbs extended in a straight line, it is bound to stick at the pelvic inlet. This happens every day when the fœtus is upside down, or when a limb or the head is turned back in the uterus, the fœtal diameters being thereby increased and exceeding those of the mother. The latter, represented by the bony pelvis, are unchangeable, hence the size of the fœtus must be decreased by straightening the extremities, altering the position, or by amputating one or more limbs.

The word *Presentation*, it should be explained, is used to designate that portion of the fœtus which first enters the pelvic inlet or passage of the dam; thus the term "Anterior Presentation" means that the fore parts are coming first, that is, they are presented and can be felt at the entrance to the pelvis, or in the vagina. Sometimes they are outside the vulva. Birth takes place almost as readily in the posterior as in the anterior presentation; but in the former the young animal is more often born dead, or in a moribund condition. This is due to compression of the umbilical cord, or extensive separation of the placental membranes, before the fœtus is able to breathe. The third presentation, the transverse, is rare, decidedly abnormal, and mostly confined to the mare. Here the foal lies across the pelvic entrance, mostly on its side.

The word *Position* is less easily defined. It expresses the relation of a certain portion of the fœtus to the pelvic inlet of the mother. For purposes of description, it is convenient to choose a fixed point on the fœtal body—the withers for the anterior longitudinal presentation, the loins or lumbar region for the posterior presentation, and the head or cephalic region for the transverse presentation. An example will show what is meant. Suppose the fœtus is upright, and the fore parts are in the passage, as in Fig. 328. Clearly, the dorsum (withers) of the fœtus is opposed to the sacrum (spine) of the dam. The term *dorso-sacral*, therefore, indicates the position. Similarly the term *lumbo-sacral* indicates that the lumbar region (loins) of the fœtus is opposed to the sacrum of the mother (Fig. 334). Here it is obvious that the young animal is coming the wrong way, hind legs first; but the position is again upright, because the spines of mother and offspring correspond. It will be noticed that the first part of the compound word refers to the fœtus, the second to the dam; the whole indicating very briefly, not only the position of the fœtus in relation to the mother, but also the presentation or part which first enters the pelvis.

Abnormal or Unnatural Presentations.—No work is more exacting, requiring more sound judgment and resource, than the handling of dystocia in the larger animals. No two cases are quite alike, and the obstetrician must possess plenty of patience and common sense, as well as the skill acquired by long practice. Furthermore, he must be prepared to adapt himself to circumstances as they arise. Yet in fairly simple cases—and most dystocians are simple at the outset—the stock-owner or his "handy-man" can render useful service if he will but keep cool, "make haste slowly," and observe certain elementary rules and precautions. One common mistake is to assume that the fœtus must be extracted within a given time, and at all costs. Another is to rope the first parts encountered and to pull on them without discovering whether the feet are neighbours, or whether they belong to the same animal. Not infrequently we have found men pulling on a fore and a hind foot belonging to the same or different fœtuses. Yet they wonder why they are unable to extract the foal or calf! Still another fault is the failure of the novice to push back one limb (after attaching a cord to it) in order to get up another, which is folded back and, possibly, beyond reach. It should be distinctly understood, as the chief axiom in difficult labour, that there is no room at all in the maternal passage in which to bring round the head or a limb; nor can the young animal be rotated or turned in this situation. Attempts to do so only result in serious injury to, and sometimes the death of, the dam. But there is plenty of room back in the womb, and the farther the fœtus is pushed back the easier the operation becomes. It follows that *repulsion*, or pushing back the fœtus, is the most important obstetrical manœuvre, and the one most frequently practised. In addition to repulsion the following measures and precautions require to be observed in very many cases of difficult birth:

1. Secure the parts presented with suitable ropes or cords (not necessarily for immediate traction). Slip nooses, for example, are applied to the fore fetlocks and the lower jaw. Keep the cords always tense to prevent slipping. Never be afraid to lose sight of a foot, but remember which it is, and mark the cord attached to it.

2. Identify the limbs (fore and hind), the presentation, and the position. In order to distinguish a fore from a hind limb lying far back in the vagina or uterus, remember (*a*) knees and hocks bend in opposite directions, the knees being broad from side to side, the hocks from front to rear; (*b*) the fore fetlocks and knees bend in the same way, the hind fetlocks and hocks in opposite ways; (*c*) the fore foot is slightly larger and the shank or cannon bone shorter, although this may prove of little assistance in the process of identification.

3. In the anterior presentation, soles of fore feet are downwards; in the posterior, soles of hind feet are upwards. If they point in the opposite direction, fœtus is on its back.

4. Never put cords over the membranes; tear

these away. Use the hands as much as possible; they are the best and safest instruments.

5. Secure the dam, alter her position, as required, *e.g.* standing, recumbent, or lying on either side. Use bull-dogs for cow, if necessary, twitch or rope hobbles (seldom required) for mare. Where much force is applied, prevent dragging the mother by attaching a rope to horns, raising hind parts, passing a cart rope, sacking, or breeching, or even the joined hands of two assistants round the hind quarters. The mare's fore foot may be picked up when the hand is first introduced into the womb.

6. From time to time inject large quantities of lubricative fluids into the dry, contracted, often swollen vagina and uterus, *e.g.* linseed tea, cresol solution ½ per cent (disinfectant as well as lubricant), rape or linseed oil. First check the straining, elevate hind quarters, and disinfect hands, tube, and external parts of animal. Repel fœtus a little, if required, and introduce a long rubber tube far into the uterus, attach a good pump, and inject several pints of fluid at blood heat, or as much as the womb will hold. Remember it is useless merely to syringe out the vagina. Not only does the fluid act as a lubricant, but it distends the uterus, stimulates its contractile power, and affords room for the easy and safe delivery of the fœtus.

7. Check the straining as follows: (*a*) raise hind parts with turfs, straw, litter, etc. In byres and cow-sheds the channel may be filled up with battens, soil, or turfs over which plenty of straw is laid. The raised position also assists repulsion. (*b*) Give a sedative, such as one to two ounces of chloral hydrate, or one to two wineglassfuls of laudanum, to cow or mare (see "Inversion of Uterus"). With the mare chloroform is particularly useful in bad presentations (Figs. 332, 333, 337, 338, and 339). (*c*) Pinch cow's back behind withers, or, better still, tie a soft rope loosely round chest and tighten up with a stick, but not sufficient to make her lie down. (*d*) Opening the windpipe may be practised in extreme cases to prevent the animal taking a deep breath and bearing down with all her strength.

8. Make sure the extremities—head and feet—belong to the same fœtus (see twins).

9. Lubricate and disinfect hands and arms, as described. If decomposition of the fœtus has set in, the operator must protect himself by thorough and repeated disinfection.

10. There should be plenty of floor space behind the animal for assistants pulling on the ropes.

11. Empty bladder and rectum, if necessary.

12. For assistants, traction and removal of extremities see "Obstetrical Operations and Manipulations."

13. Be careful to pull on the ropes during the pains, and to stop during the intervals. The direction should be upwards, straight backwards, and lastly downwards as birth proceeds.

With the exception of Nos. 328 and 334, which portray normal birth, the *figures* represent the principal malpresentations and malpositions assumed by the foal at parturition. They apply equally to the calf and to other animals.

FIG. 328. **Anterior Presentation: Dorso-sacral Position.**—Nose of foal rests on or near fetlocks; head, neck, and fore limbs fully extended. This is the most natural arrangement, and the one generally assumed in normal births. Soles of fore feet are directed downwards. Assuming that the dam is healthy, no impediment to easy delivery exists.

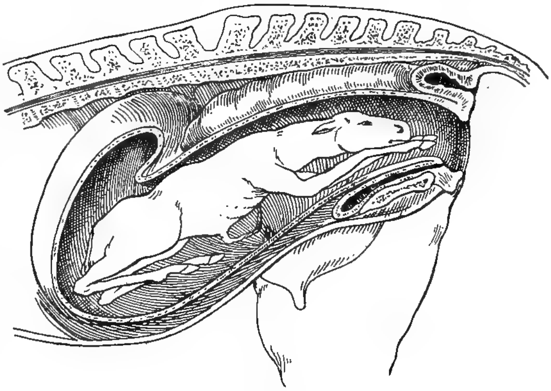

FIG. 328.

Variation.—Jamming of Stifles or Hips at Pelvic Inlet.—Parturition proceeds naturally until the head, fore limbs and shoulders are born, when further advance becomes impossible. This dystocia seldom occurs in animals other than the cow, in which it is not infrequent. The calf is usually large, and both its hips pass together into the pelvic entrance, and become firmly wedged. Sometimes the obstruction appears to be due to the stifles being partly flexed and catching on the pelvic brim. The elbows may be caught in a similar manner (Fig. 330, variation 3). The accident is more likely to occur if traction is exerted in an upward or straight backward instead of a downward direction during the later stages of labour. Delay in summoning skilled aid, as well as excessive and misdirected traction, causes fœtus to jam so tightly that it cannot be moved backwards or forwards; the maternal parts also become dry and contracted, and the hand cannot be introduced into uterus. In ordinary circumstances, repel calf a little, lift stifles by pulling downwards on the fore parts, and, more important still, pull obliquely on one rope at a time, in order that one stifle or hip may enter the pelvis before the other. If the calf is pulled downwards towards the hocks immediately birth is arrested, nothing more may be required. Failure of these measures calls for alteration in the position of cow; turn over, or place on back if recumbent, or sling up by hind legs. Inject fluids into womb whenever possible. As a last resource, and without undue delay, amputate a fore limb, remove the internal organs of fœtus, and divide its pelvis with a long sharp chisel.

FIG. 329. **Anterior Presentation: Dorso-pubic Position.**—Foal on back, its withers or "dorsum" corresponding to pubis of mother. Hence the term *dorso-pubic.* The heavy head tends to drop below the pelvis towards bottom

of womb. In the figure, however, the head is somewhat advanced in the passage. The soles of fore feet are directed upwards. Occasionally the mare manages to foal herself, but the cow seldom calves without assistance. *Delivery.*—In the absence of head, make sure you have knees, not hocks, to deal with. Cord feet and lower jaw if available; push back fœtus with arm or crutch, and attempt rotation by turning the young animal on its long axis so as to bring the withers uppermost. Do this by placing hand under withers, and pressing from left to right or right to left, while an assistant crosses the fore legs and twists in the same direction. If the legs are sufficiently advanced outside the vulva, strap a board between them, and so gain more leverage. With roomy animals, especially mares, when the maternal parts are well relaxed, endeavour to pull the foal or calf away as it lies; but straighten head as much as possible, pull upwards towards tail to give more room for passage of head, and avoid too much force. If rotation fails in the cow, cast, turn on back, inject fluids, and deliver calf in an upright position. Remove a fore limb, if necessary, but this is seldom required.

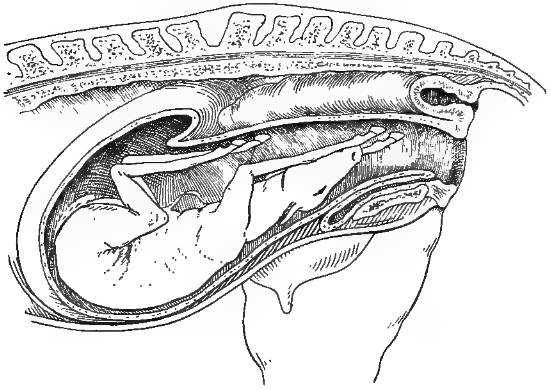

Fig. 329.

Variation.—Fœtus upside down, head turned back on side (Fig. 332). This is a bad presentation in both mare and cow. Amputate fore limbs at once at the shoulder. Even then it is difficult to bring the head forward after placing a hook in the orbit. As in Fig. 329, the head and body of fœtus gravitate towards lowest part of uterus. The body is also curved, and it takes up much more room than in the upright position. When confronted with this complication in the cow, we prefer to cast the animal and place her on her back. Amputation of one fore limb may then suffice to get the head.

Fig. 330. **Anterior Presentation : Carpal Flexion.**—Both fore limbs bent back at knee; head in passage; knees in contact with the pelvic brim. The cannon or shank bones are parallel to, and just below, the forearms, while the shoulders are bulged out and unable to pass through the pelvis (compare shoulders in Fig. 328). The diameters of the fœtal chest are further increased by the feet and fetlocks, in addition to the shoulders and arm. The cow's narrow pelvis gives more trouble than the mare's. Flexion at the knee, one or both, is perhaps the commonest form of dystocia in the cow. *Delivery.*—Feel the head and knees; the foal's fore feet are generally beyond reach. If head is outside vulva, amputate immediately at first joint, dissecting back skin, tying it over the bone, and leaving end of cord outside. It is often very difficult to push back the foal's head, and impossible in the case of the calf. More commonly, head is in passage; here cord lower jaw and raise hind quarters of dam with bunches of straw to lessen pressure and straining, and to obtain the assistance of gravity. Guide crutch (repeller) with hand in vagina, fix it against brisket, and push foal well back. An assistant should exercise constant pressure on the crutch. Before or during repulsion, coil up looped end of cord in hand, pass it through bend of knee, draw it outside vulva, insert free end of cord through loop, and slip the running noose thus formed up, and tightly round the limb. Continue the repulsion while pulling on cord round knee, thus drawing knee upwards and forwards, and permitting a cord to be placed round pastern. The next step is to straighten the limb. With foal far back in uterus, press knee *outwards* towards flank of dam and bring foot round *inwards*, while an assistant pulls on cord attached to foot. In executing this manœuvre, take care to double foot back into hollow of pastern, protect foot with hand, and bring it round quickly as it impinges on the pelvic brim. Also wait for an interval in the labour pains, or foot may be forced through uterus (see "Rupture of Uterus"). Bring round other limb in the same way after again repelling fœtus. Gentle traction will now accomplish delivery.

Variations.—(1) One fore leg presented, other limb and head back. See "Deviation of Head," Fig. 332.

(2) One fore leg doubled back at knee, the other extended alongside head and sometimes outside the passage. The case is simpler than Fig. 330, although the bent knee may press against pelvis and obstruct delivery. Proceed to get up the retained limb as before. If foal is alive and difficult to repel, with flexed knee near vulva, extract fœtus in the false position, provided there is room and moisture (lubrication, natural or artificial). To accomplish this, cord the presented limb and head, and also forearm of retained limb; pull the latter cord upwards, pressing cannon bone close against forearm, thus preventing the retained foot being driven through vagina.

(3) Head and two fore limbs presented, elbows flexed. At first sight the presentation seems natural, but traction fails to effect further progress. Note that the nose is too far forward in relation to the feet, sometimes beyond them, due to incomplete extension or straightening of the fore limbs. The hand detects points of elbows below the pelvic entrance, and pressed hard against it. The elbows are caught on the pelvic brim, and the shoulders are also too prominent. Delivery is simple, once the obstruction is located. Cord extremities (head and fore feet); repel fœtus a little; introduce hand, palm upwards, under elbow and lift it over the bony ledge; simultaneously, assistants pull the limb in an upward direction. Handle other limb in the same fashion.

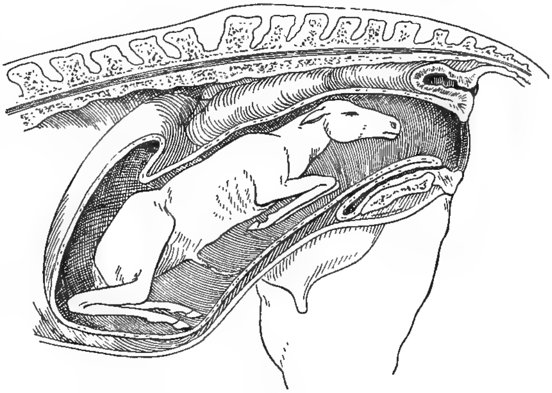

Fig. 330.

(4) Fœtus sticking at the shoulders. As before, parturition appears normal up to a certain point, when progress ceases. On examination, the elbows are clear, but the shoulders are wedged at pelvic inlet. Repel, and advance one shoulder at a time by pulling alternately and obliquely on the limbs.

Fig. 331. **Anterior Presentation : Complete Retention of**

one Fore Limb.—Retained limb is bent backwards under body of foal, and proves an insuperable obstacle to normal birth. The shoulder-blade is forced back on side of chest and bulged out. Head is farther advanced than in Fig. 330, sometimes outside vulva, with one fore limb alongside it. If the hand can be introduced into the vagina on the side of the missing limb, it meets the shoulder at the pelvic inlet. At the outset, the case may be one of simple carpal flexion; but, owing to the powerful straining efforts advancing the fœtus, the bent knee is pressed against the pelvic brim, and the whole limb is gradually forced back into the uterus. The partial retention thus becomes complete. *Delivery.*—As usual, cord the parts presented, that is, the head and fore foot; then repel fœtus towards roof of uterus. Repulsion acts in two ways—not only does it give room to manipulate the missing limb, but it causes the shoulder to slip forward on the chest wall. This brings the forearm within reach, and enables a cord to be passed round it near the knee (Fig. 331). The farther the foal is pushed back, the more the retained limb is straightened and comes into the hand. Now pull upwards on cord attached to forearm, continue the repulsion, and in this way bring the leg into the position shown in Fig. 331. Then proceed as directed. The head is always the chief difficulty. When lying near the pelvic entrance it is easily forced back into the womb; at the vulva, however, it should be promptly amputated, as above, and the stump pushed in an upward direction during repulsion. For the foal is dead, and the calf, if alive, must be sacrificed to save the dam. It is seldom or never justifiable to pull away the foal or calf by main force without correcting the deviation. Nevertheless the lamb and kid are sometimes successfully delivered in this position.

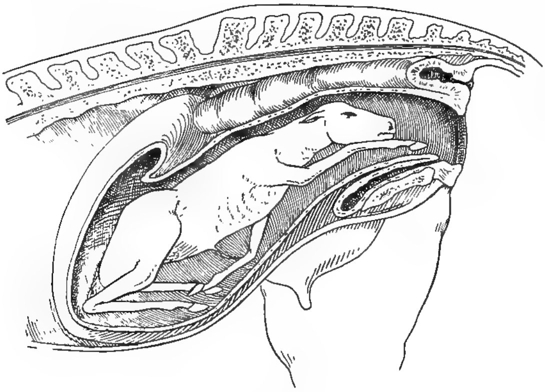

FIG. 331.

Variations.—(1) Both fore limbs completely retained. This is called "Shoulder Presentation" by some writers, because the shoulders are presented at the pelvic inlet—indeed, they can get no farther—while the head is at, or near, the vulva. Proceed as before. Remove head, leaving plenty of skin tied over bone, and end of cord hanging outside. Press stump upwards and backwards into uterus, and get legs up, one at a time.

(2) Head and one fore limb far back, other fore limb presented (see Fig. 331).

(3) One fore limb crossed over neck. Both feet on same side of head, the crossed one being much farther back in the passage. Mostly seen in mare, but very uncommon. Check straining, raise hind quarters of dam, secure feet and head, cover crossed foot with hand, and lift it over poll into position. First see that the rectum (back bowel) is empty, and straighten limb before pulling. The principal difficulty is the violent straining of mare, which may drive foot through roof of vagina, and even into the rectum and through the anus.

FIG. 332. **Anterior Presentation: Lateral Deviation of Head.**—Both fore limbs in passage; head turned back on side of chest, often beyond reach. The fore foot on same side as head is less advanced, indicating side on which head lies. This presentation in the foal is almost as frequent as, and certainly more serious than, retention of a limb. The foal's long neck is readily bent round, so that head lies on posterior ribs or flank; whereas the calf's short neck does not permit head to pass beyond shoulder or chest wall. With the pig, on the other hand, this serious deviation seldom or never occurs. Traction on the fore limbs only makes matters worse by forcing head farther back and wedging foal in the pelvic entrance. Pulling on the fore feet without examining the position of head is a very common fault. The head may be deviated upwards, downwards, or to one side. As a rule, it is displaced laterally, as in the figure, and the bent neck then blocks the pelvis. When the head is missing, determine its position by feeling the withers and mane above and the windpipe below. The presentation is aggravated by the early death of the foal, traction on the limbs, and the expulsive efforts of the dam. The calf's head is generally within reach, although only tip of ear may be felt at first. *Delivery.*—Observe the preliminaries mentioned. If recumbent, never allow dam to lie on the side to which head is turned. Give sedatives for the straining, elevate hind parts, and attend to lubrication and repulsion. The statement that the farther the fœtal body is repelled the more the head is likely to advance is not a paradox; it is a fact. Therefore place crutch against sternum (brisket) and keep it there, pressing steadily away from the side to which head is turned. Once the ear is reached, it is only a matter of time before the eye socket is secured with a blunt hook. Pull on cord attached to this hook, reach the nose, and rope the lower jaw. Then bring head into the straight. In place of a cord on jaw, some prefer to insert a hook in angle of mouth. In the calf, however, unless the head is far back, hooks may often be dispensed with. Not infrequently the foal's head is quite out of range; if so, try alternate raising and lowering of hind quarters, change mare's position, pull out and repel the fore limbs, and fill the uterus with fluid to float the fœtus. These simple measures are, in some instances, surprisingly successful. Nevertheless, in most cases, embryotomy is required; for it is seldom that a calf or foal can be delivered with the head back without fatal results. Embryotomy (amputation of a limb, etc.) is also required when the fœtus is so wedged in the pelvic inlet that it cannot be moved backward or forward. In such cases it may be impossible to pass hand into uterus. The operation is practised by skinning and removing a fore leg at the shoulder, the one which is more advanced away from the head. Owing to the calf's large head, both limbs may have to be amputated in order to secure plenty of room

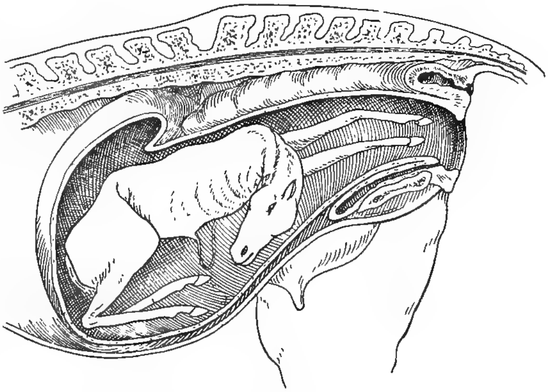

FIG. 332.

in which to bring the head round; or, under very favourable conditions, to extract the fœtus with the head back. But it may also be necessary to incise the entrance to the chest, remove the first ribs, and tear away all the viscera. The fœtal body then collapses. In all cases of deviation of the head, including the variations 1, 2, and 3, the hand should be kept alongside the head as it traverses the passage of the dam. This prevents further deviation after the neck has been straightened.

Variations.—(1) Head and one fore leg back; other fore leg presented. Secure the latter; push back fœtus; get up the missing limb, as in Figs. 330 and 331; then proceed to get the head as above.

(2) Downward deviation of head. Here the fore legs are presented, as in Fig. 332, but head is depressed between them. This presentation is uncommon. Nose of fœtus drops towards sternum, and poll, or upper part of neck and mane, is presented together with one or two fore limbs. Traction on limbs, or even each succeeding labour pain, pushes head nearer bottom of womb. On examining a bad case in the mare, only the withers may be felt; but the calf's ears can generally be reached. In either animal the nose may be lying only a short distance below the pelvic brim, allowing hand to be placed under it, and a blunt hook in the orbit, sometimes even the fingers in the nostrils, by which means head is lifted into the passage during repulsion. A slip-noose in the mouth round the upper jaw may assist in raising head. Begin by cording fore feet and repelling in an upward direction, in order to separate the fore legs and allow head to rise between them. If unsuccessful, amputate a limb.

(3) Upward deviation of head, one or both fore limbs in vagina. In this variation, head is turned backwards and upwards on back of fœtus. The presentation is rare. The hand encounters lower part of neck, or front of chest, at the pelvic entrance, and the windpipe is easily manipulated. Proceed as before. Repulsion of fœtus as far back as possible with crutch firmly fixed against chest gives head a chance to drop. Pull head downwards when reached, and straighten it. Remove a fore limb, if necessary.

(4) Wry-neck in foal. This is a form of lateral deviation confined to the foal, associated with deformity and distortion of head and neck. The presentation, which is a most serious one, is often anterior, with both fore limbs in passage. Occasionally it is transverse, the foal lying across the uterus, as in Fig. 338. The fœtus grows in this false position from an early stage of gestation; and the muscles, etc., of neck are so contracted and rigid that it is impossible to straighten neck either inside or outside the womb. The head is frequently beyond reach on the flank or quarter. Delivery is effected by removing both fore limbs. Occasionally one limb may suffice, provided evisceration (removal of the internal organs) is carried out. Amputation of the neck is a much more difficult operation.

Fig. 333. **Dog-sitting (Anterior) Presentation.**—Foal doubled up; hind limbs forward under belly; five extremities presented in passage or pelvic inlet. The soles of both fore and hind feet are directed downwards, a fact which assists diagnosis. The presentation is fortunately uncommon, and mainly confined to the mare; but it is one of the worst with which the obstetrician has to deal. The foal is generally upright, that is, in the dorso-sacral position. The vagina is filled with head, neck, and three or four limbs, so that it is very difficult to introduce the hand. As a rule, progress ceases when the head and fore limbs are at or near the vulva. These extremities are first encountered, and the temptation is great to cord and pull on them without examining the position of the hind feet, which lie farther back. Traction so exerted, or the violent straining of the mare, often drives the hind feet, or points of hocks, through floor of uterus or vagina, causing rupture and death of dam from uterine hæmorrhage. If labour pains suddenly cease, suspect rupture (see "Post-partum Hæmorrhage and Rupture"). *Delivery.*—Send for veterinary surgeon if moderate traction fails to advance foal, or immediately the hind feet are met with. Make a pit for mare's fore feet, or pack hind ones high up. Also check the straining. Frequently the foal is found too far advanced, and firmly jammed in the pelvis, when formidable embryotomy operations must be performed. The bulk of the foal may, however, lie in the uterus, and its extraction as it lies has been attempted by pulling on all the extremities, and drawing the hind limbs upwards; but the mare nearly always dies, while the foal is already dead. In the early stages (and delay is fatal, as a rule) straight porte-cords, as described under "Obstetrical Operations," are attached to ropes round the hind pasterns, in order to repel the fœtus. It *may* then be possible to straighten the hind legs far back in the uterus. The presentation is one in which it is important to distinguish between the fore and hind extremities (p. 1057, obsv. 2).

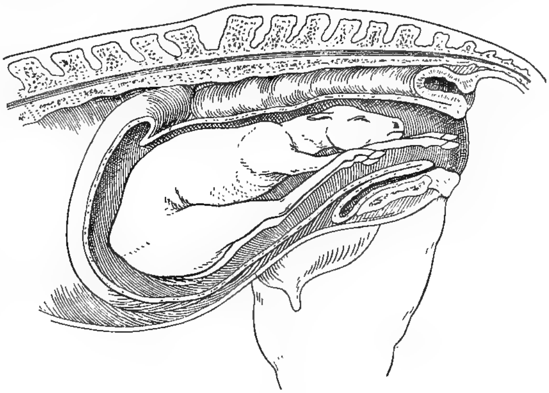

Fig. 333.

Fig. 334. **Posterior Presentation: Lumbo-sacral (Normal) Position.**—Foal upright; hind feet presented, soles upwards. Parturition often takes place without assistance.

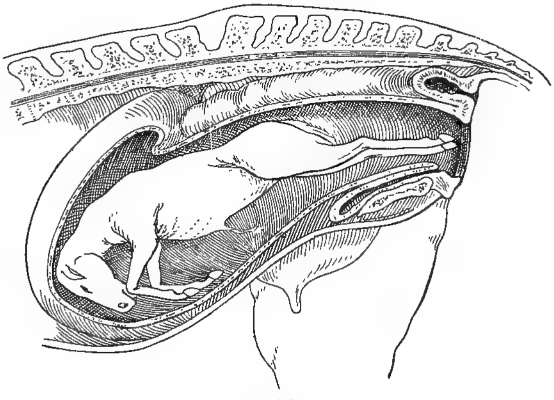

Fig. 334.

Remarks under Fig. 328 apply here. Although early pressure on umbilical cord causes death of foal sooner than in the anterior presentation, many calves coming the wrong way are born alive.

Fig. 335. **Posterior Presentation: Lumbo-pubic Position.**—Foal on its back; hind feet pressed against roof of vagina; buttocks sunk below the pubic brim, forming the chief obstacle to birth. Note that foal's lumbar region (loins) is opposed to the maternal pubis (floor of pelvis); hence the term "lumbo-pubic." In some cases the hind feet are still in the uterus, doubled up at the fetlocks; and the straining efforts may force them towards the rectum

instead of through the neck of womb. On examination it may be found that the "os" is imperfectly opened up. If so, never attempt hasty and forcible delivery. Rather exercise gentle traction on hind limbs for a considerable time in order to excite uterine action, and complete the dilatation of the os. *Delivery.*—See Fig. 329, and proceed in the same manner to turn the fœtus round into the upright, or extract in the false, position according to circumstances. The latter, broadly speaking, should only be attempted in mares, and when the dam is roomy and the foal moderate in size. In delivering the foal as it lies, attach cords to hind feet and pull downwards. When progress is arrested through points of hocks catching on the pelvic brim, pass hand palm upward beneath the hocks, and lift them, one at a time, into the pelvic canal. As soon as hocks and feet are clear, pull in an upward direction to lift the buttocks.

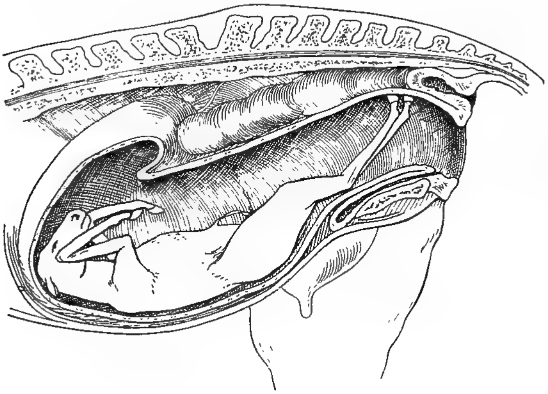

Fig. 335.

Fig. 336. **Posterior (Hock) Presentation: Partial Retention of both Hind Limbs.**—Hocks fully flexed at entrance to pelvis; hind feet pointing backwards away from the vulva; fœtus upright in lumbo-sacral position; hind limbs completely folded or doubled up, constituting an effectual barrier to birth. On examination the hand meets points of hocks in passage, at pelvic inlet, or below it. The tail may be close at hand, or turned over back, while the buttocks are felt just above hocks. Sometimes called "tarsal flexion," the presentation is analogous to "knee flexion" (Fig. 330). But it is more serious on account of the extra length of the hind legs, and the fact that the hock and fetlock flex in opposite directions. This makes a hind limb more difficult to push back and turn round in the uterus, and necessitates greater care to avoid injury to the dam. *Delivery.*—Observe the usual preliminaries (straining, elevation, and injection of fluids, etc.); then proceed as in "carpal flexion" (Fig. 330). Place crutch under tail, keep it there with steady pressure, and repel in an upward direction to clear the hocks and enable hand to reach lower part of limb; then attach a cord to calf's fetlock. With the foal, and occasionally the calf, the foot can seldom be reached for some time. It is necessary in the first place to pass a cord round the limb just below the hock, as in the case of the knee. This is accomplished by seizing end of cord from opposite side of limb, bringing the end thus passed outside the vulva, and making a noose or loop on it, if a spliced loop is not already present. The other end of cord is now inserted in the loop, and the running-noose which is formed is slipped up round the limb, and drawn tight. A proper calving rope has a fixed loop at one end intended for the purpose. When the calf's hind legs are extended downwards towards the udder, it is often possible with the exercise of a little patience to reach lower down the limb, and to slip the running-noose adjusted below the hock down as far as the fetlock before pulling it tight, thus dispensing with a second rope. Pulling on the upper cord, when this is in position, gradually brings the foot of the foal into the hand, provided repulsion is steadily and continuously practised by an assistant. Push also on the point of hock during the straining intervals, and get it well back into the womb. Now slip a second noose over the foot round the pastern, pull on this cord, press hock upwards and outwards toward the mare's flank, bend toe back into hollow of heel, keep it covered with hand, and in this way bring it round inwards into the passage. Needless to say, much of the necessary traction and repulsion is performed by assistants, who must be thoroughly under the control of the operator, while the latter concentrates his attention on the various manipulations required within the womb, and, incidentally, husbands his own strength (see "Traction," p. 1066). With one hind limb adjusted, the other is brought round in the same way. It cannot be too strongly emphasized that the somewhat dangerous manœuvre of turning a hind limb can only be safely accomplished with the fœtus, foal, or calf pushed back very far into the uterus so as to obtain the maximum amount of room. With both limbs in position, delivery by easy traction is accomplished. Another method is occasionally adopted, as in other presentations, consisting in the extraction of the fœtus as it lies, without straightening the limbs. The method can seldom be recommended, for it more often proves fatal to the mother, although small fœtuses, especially twins, may be successfully delivered in this way. If attempted, cut through the tendon known as the "hamstring," a little above point of hock, and take care that delivery is accomplished before the maternal parts become dry, swollen, and bruised. In heifers we have no hesitation in saying that the calf should seldom or never be brought away with the hocks flexed. Yet it must be admitted that roomy mares now and then manage, by violent efforts, to expel the foal spontaneously; but they are very liable to tear and lacerate the vagina and neck of womb (cervix). A better plan, particularly when fœtus is tightly jammed in the pelvic inlet, is to cord lower part of thigh, and amputate limb through the hock-joint, removing lower portion of limb with the hand. After treating the other leg in a similar manner, the fœtus is withdrawn by pulling on the cords attached to the thighs.

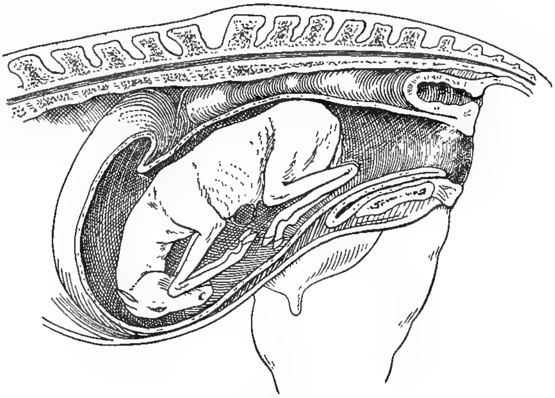

Fig. 336.

Variation.—One hind limb presented, foot near or outside vulva; other hind limb partially retained, as in Fig. 336, with point of hock in vagina or at pelvic inlet. Delivery in this false position is easier than when both legs are back, especially if the "hamstring" of a dead fœtus is divided. It is safer, however, to repel fœtus, and to proceed as above. The choice of method depends on the circumstances of the case, and these show considerable variation.

FIG. 337. **Posterior (Breech) Presentation, or Thigh and Croup: Lumbo-sacral Position.**—Complete retention of both hind limbs; tail and buttocks at pelvic inlet, blocking the birth canal; hind limbs fully extended under abdomen and chest of fœtus. Sometimes, in pot-bellied cows and mares, the legs are directed almost straight down towards the udder. The presentation is most serious in these animals, but gravest in the mare, in which it ranks with "dog-sitting" (Fig. 333) as the most formidable and dangerous of abnormal presentations. In any animal, delay in rendering assistance, or the straining efforts of the dam, may cause the incomplete or "hock" presentation to become a complete or "breech" presentation. To add to the difficulties of the case, the strong expulsive efforts of the mare prove a great hindrance to manipulation, besides tending to wedge the fœtus firmly in the pelvis. Furthermore, rupture of the vagina or uterus is not uncommon from penetration of the feet or points of hocks. Examine in the standing position; or, if recumbent, turn the dam on her back. With the hand in the vagina, feel the buttocks, the anus, and perhaps the tail pressed against the pelvic inlet. The hocks are generally beyond reach; indeed, it may be quite impossible to force the hand into the uterus. *Delivery.*—Before anything can be accomplished, it is essential to administer a powerful sedative, and to elevate the hind quarters to a marked extent (p. 1058, obsv. 7). In all cases in the mare, our advice is to chloroform without delay, and place in the dorsal position, that is, on the back. Cows are also more easily handled in this position, and both animals may with advantage be suspended, or slung up, by means of ropes attached above the hocks. As soon as the fœtus gives or slips back a little, permitting the introduction of a stout rubber tube into the uterus, pump in several quarts of linseed tea, etc. Then push back fœtus by means of a stout repeller, with the crutch end firmly implanted in the region of the anus, or against the buttocks. This allows the hand to enter uterus, and affords room to pass a half-inch cord round thigh in the manner described under knee and tarsal flexion (Figs. 330 and 336). Pulling on this cord in an upward direction, while continuing the repulsion, raises and flexes the hock, and brings the limb into the position shown in Fig. 336. The other limb is similarly handled, when the presentation becomes one of tarsal flexion, which is dealt with as described. Unfortunately, efforts to repel the fœtus may prove of no avail on account of the wedging of the buttocks in the pelvic inlet, the powerful straining excited by the pressure of the crutch in the absence of anæsthesia, together with the dry, swollen, and contracted condition of the maternal passage and womb—impediments to delivery which can only be partially overcome by the methods already enumerated. A less serious difficulty occurs through the hocks catching below, or on the edge of, the pelvic brim. Further repulsion, especially in an upward direction, will, as a rule, remove this obstacle, and permit the hocks to be raised. Full use should also be made of the strong cords attached to the thighs, traction and repulsion being employed simultaneously. Nevertheless firm wedging of the fœtus generally means the knife, the use of which should not be delayed in the mare if the hocks cannot be reached. The embryotomy operations include the amputation of one or both hind limbs, and sometimes the removal of the internal organs. It is possible for a comparatively small calf or foal to be born with the hind legs right back without causing the death of the mother; but rupture is very liable to occur from the excessive force required to drag a large fœtal mass through the small birth canal. The procedure should never be attempted in complete retention of both hind limbs.

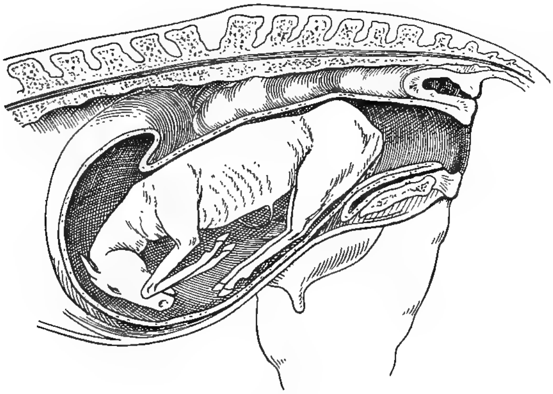
FIG. 337.

Variation.—One hind limb presented, with foot near or outside vulva; other hind leg fully retained under fœtal body. The presentation, although still serious, is less grave than Fig. 337. It is analogous to Fig. 331. Proceed as indicated above. Extraction in this wrong position is not so difficult in small animals. In mare and cow it may be attempted, in the favourable conditions mentioned, by securing the presented limb, cording the other thigh, and inserting one or two blunt hooks in the fœtal pelvis to which strong half-inch cords are attached. The insertion of sharp single or double hooks in the hips, recommended by some writers, is a dangerous practice. Unless parturition has been too long delayed, a better plan is to cord the presented limb and push it back with the aid of a straight porte-cord (cord-carrier), while the body of fœtus is repelled, if necessary, with the hand or crutch. This enables the operator to get hold of the missing limb.

FIG. 338. **Transverse (Sterno-abdominal) Presentation: Left Cephalo-ilial Position.**—Foal lying across the uterus; lower surface of chest and abdomen towards pelvis; all four limbs in passage. Head rests on left ilium (pelvic bone) of mother, hence the term "left cephalo-ilial," indicating side on which head lies. The heavy head frequently drops towards floor of womb (not shown in figure). The limbs, too, are often crossed, and only partially extended or straightened; they completely occupy the passage, rendering it very difficult to introduce the hand and make a proper examination. The presentation, like Figs. 333 and 337, is more or less grave. An embarrassing feature is the presence of a bunch of limbs in the vagina, which may easily lead one to suspect twins, or even a monster. According as the front or rear limbs are more advanced, the presentation approaches the anterior or the posterior, rather than the transverse. With three or four feet near the vulva, it is clear that birth cannot proceed owing to the body of the fœtus being unable to enter the pelvis. *Delivery.*—Cord all the feet after carefully distinguishing fore and hind legs; mark the ropes. As soon as possible determine whether the limbs belong to the same fœtus, *i.e.* that it is not a case of twins. Trace the legs upwards towards the body, and try the effect of repelling one end of fœtus and advancing the other. When called in early, the veterinary surgeon is often able to turn the *calf*, and deliver the hind legs first. Elevate, attend to straining and lubricating fluids, push back fore feet with hand, press against

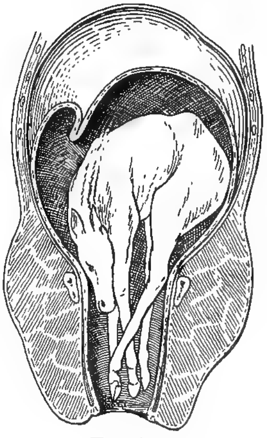
FIG. 338.

point of shoulder when reached, and flex the knees as they slip back into the womb. Assistants then pull on the hind feet, while the fore parts are continuously repelled, and delivery is effected in the longitudinal (posterior) presentation. The turning movement, it will be remembered, can only be carried out back in the womb; but it may prove impossible to execute in the case of the *foal* on account of the length of limb, the excessive and powerful straining, and the malposition of the head (often round on the side of foal and out of reach). Indeed, the legs may be jammed in the pelvis, and repulsion is then impossible. The condition known as "wry-neck" may be present as a complication (Fig. 332, variation 4). Nevertheless, if circumstances permit, adopt the same procedure as in cow. Delivery in the posterior presentation is to be preferred, because the operator has but two extremities to handle, while the fore legs are easier to repel. It may, however, prove a simpler matter to push back the hind and advance the fore parts; but the head is a disadvantage, owing to the difficulty in securing and straightening it, and bringing it into the passage. With the mare it is advisable to cast and chloroform, place on either side or on back according to position of head, etc., raise hind parts high, inject fluids, and apply crutch provided with a sharp spike against breast-bone or in arm-pit of foal. In the event of failure, push back hind legs, pull out the fore ones, one at a time, and amputate at the shoulder, or as high up as possible. It then becomes an easy matter to repel the chest, advance the hind feet, and extract the foal. The same method may require to be adopted with the calf.

Variations.—The fœtus may present at the pelvic inlet with the limbs in different positions. For example, the vagina is empty, the foal lies across the pelvic inlet as before, but its body is doubled up, and its limbs are drawn up under the body in a flexed position. No part of the foal has entered, or can enter, the pelvis. In some instances the points of the hocks are encountered, and the hind limbs are firmly fixed across the womb. Here the fœtus may be hamstrung, as in Fig. 336. The obstetrician must act according to circumstances, and deal with complications as they arise. Amputation at joints below the shoulder and hip has often to be performed. Transverse presentations may also require the opening of the foal's chest or abdomen and the removal of the viscera.

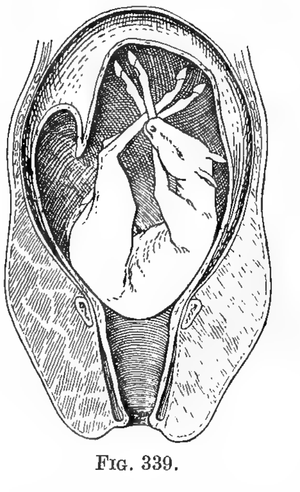

FIG. 339.

FIG. 339. **Transverse (Dorso-lumbar) Presentation: Right Cephalo-ilial Position.**—Foal across the uterus, but head to the right, with back and loins presenting at the pelvic inlet. It will be observed that the fœtus reaches the pelvis by its back and loins, whereas in Fig. 338 it presents in the opposite way. The presentation is even more serious than the latter, but fortunately it is rare, and, like Fig. 338, mostly confined to the mare. No part of the fœtus can possibly enter the vagina, the limbs being beyond reach and directed away from the pelvis. On manual examination, a hairy mass is recognized pressed against the pelvic entrance, sometimes covered by the placental membranes. On tearing these away, the hand encounters the curved backbone and the ribs, while on further manipulation it is generally possible to distinguish the shoulders or hips. The fœtus often lies in an oblique, not exactly transverse, position, presenting at one time the loins, croup, and tail, at another, the neck and shoulders, and, occasionally, some part of the head. As in all transverse presentations, the heavier hind quarters sink to a lower level. *Delivery.*—Attend to the usual preliminaries; then attempt repulsion of the fore parts in an oblique direction by means of the crutch, with sharp spike embedded in a convenient spot. As soon as the tail comes round, seize it and endeavour to get hold of the hind legs. If the fore parts are more accessible, it may be simpler to press back the hind quarters of fœtus, and to deliver in the anterior presentation (see Fig. 338). When these manipulations fail—and both are difficult of accomplishment—advance the trunk with hooks; divide it with knife, saw, and chisel; tear away the viscera; and, with the aid of hooks and strong cords, extract each half of fœtus separately. The operation is thus a formidable one.

Variation.—The writer had occasion to attend a rather unique case, in which a pair of bull-calves were successfully delivered. The first calf was presented as in Fig. 339, but half on its back, with the head missing. Efforts to repel the hind parts proved more successful than the fore, and led to a fore limb being at length drawn into the passage, and its amputation at the shoulder The other fore leg was next secured, followed by the head upside down, and the calf was eventually extracted on its back in the anterior presentation. Further examination resulted in the discovery of a second fœtus enveloped in its membranes presenting anteriorly by the occiput and poll, the fore limb being directed backwards under the body. After rupturing the membranes the head was secured, straightened, and repelled, permitting the fore legs to be brought round, one at a time. The calf being small, this was easily accomplished.

Difficult Parturition independent of the Presentation.—Cases show material differences, and the measures adopted must vary in accordance with circumstances, the best use being made of the means at hand. It need, perhaps, hardly be mentioned that the above list is necessarily incomplete, both in regard to the variations which may be encountered, and the cases of difficult birth which are independent of the presentation and position of the fœtal body, as well as the arrangement of its limbs and head. The latter include: (1) Monsters and malformations of all descriptions. (2) Twins. (3) Disparity in size—fœtus too large for the birth canal. (4) Diseases of the fœtus, such as hydrocephalus or dropsy of the cranium. (5) Difficult birth arising from maternal, not fœtal, causes due to some disease, stricture, malformation, or displacement of the maternal organs. But the same general principles will guide the attendant, no less than the surgeon, in rendering proper mechanical aid at the right time. Cautious perseverance will often succeed in effecting delivery with safety to the dam, and frequently to the fœtus. It is not proposed in the space of this article to enter into details regarding the dystocias arising from diseased conditions of the fœtus or mother, concerning which full information can be obtained from text-books on veterinary obstetrics. A *monster*, it may be explained, is a freak which exhibits some marked congenital deformity in one or more of its parts. The deformity is generally considered to be due to arrest in development of certain portions of the body or limbs, while other portions grow to an excessive extent. Monsters are not of common occurrence; in fact, they are rare in animals other than the cow and ewe. But they frequently give rise to difficult labour on account of their unnatural size and shape. Examples are met with in the bulldog calf; distorted monsters with curvature of spine and body doubled on itself; wry-neck in foals (Fig. 332, variation 4); double-headed calves; two fœtuses joined together, etc. The writer has had several distorted calves presenting transversely as in Fig. 338, but with the viscera lying free in the vagina or uterus (a peculiar and at first alarming condition), three or four limbs in the passage, ribs bare, chest and abdominal cavities absent, and the skin reflected forward over the head like an umbrella turned inside out. Owing to the existence of a double spinal curvature, the shoulders, hips, and tail were brought very close together. In such cases efforts to advance or repel the fœtus often prove fruitless, particularly when injudicious traction has jammed the parts in the pelvic inlet. If the fœtus can be moved backwards or forwards, it is noticed that the hind and fore parts invariably move in the same direction, so that it is impossible to repel, say, the fore limbs and bring forward the hind ones; the whole mass advances or recedes in one piece, and the fore parts accompany the hind during repulsion. On the other hand, in *twins*, for which the monster may be mistaken, it is generally a simple matter to push back one fœtus into the uterus and to pull forward and extract the other. This distinction is of considerable value to the operator in determining what he has to deal with when confronted with a bunch of legs in the passage. Even so, the diagnosis may remain in doubt for some time. One advantage in twin foals and calves is that they are generally small; there is more room in which to correct the unnatural presentation when it exists. Twins, however, usually cause dystocia by advancing simultaneously into the pelvis, certain extremities of each fœtus entering the canal at one and the same time. Thus the hand may meet with the hind leg of one twin lying in the posterior presentation, and one or both fore limbs, and even the head of the other coming anteriorly. More often, in cows and ewes, the head of one twin and the fore limbs of the other are presented; and the novice is much tempted to pull on these three extremities under the impression that they belong to the same animal. The rational procedure is to make a careful examination with the hand, try a little traction and repulsion to make sure, and then to push one fœtus well back to permit the other to be brought forward. A case of double dystocia in which each calf was presented in an unnatural position, but not simultaneously, is described on p. 1064 (Fig. 339, variation).

Obstetric Operations and Manipulations.—Reference to the minor procedures indicated in difficult labour has been repeatedly made in connection with the various abnormal presentations of the fœtus, while on pp. 1057-8 a number of directions are given for the guidance of the stock-owner and his assistants. Some of the mistakes habitually made by the unskilled hand have also been mentioned. These mistakes, it will be remembered, greatly increase the difficulties encountered by the veterinary surgeon, and so lessen the chances of recovery. It remains to describe the use of assistants, the application of traction, and some of the simpler operations which have for their object the reduction in size of the fœtus. The operations of which a more minute description is given are those which the owner might have to perform himself in cases of emergency, when help cannot be obtained. But such occasions should seldom arise. As a rule, the amateur should place most reliance upon the intelligent use of his hands and arms; and, with the exception of simple cords, he should be content to dispense with instruments, with the handling of which he is naturally unacquainted. In this way much useful work may be accomplished without serious or fatal injury to the dam. The writer's object is to present the principles of veterinary obstetrics in a simple and practical light. At the same time the application of the principles must be based on expert knowledge and extensive experience, which the surgeon alone possesses. After all, the *bed-rock essentials* for rational and successful interference are: (1) Plenty of common sense, perseverance, and the knack of making the best use of one's hands; (2) an elementary knowledge of anatomy and mechanics. While there is a general consensus of opinion that brains are better than force, the possession of a long head *plus* a long strong arm is often necessary to success. The problem which confronts us is to make the young animal occupy the least possible space. In fœtal dystocia this can only be accomplished by altering the presentation, the position, or the arrangement of its extremities without injuring the mother. At the same time, in deciding whether it is advisable to render assistance, not only the presentation, but the signs of parturition, the degree of relaxation of the maternal parts (especially the os), and the duration of the labour should be taken into consideration. Where any doubt exists as to the animal's preparedness to calve or foal, the introduction of the hand into the bowel or passage will furnish satisfactory evidence. At an early stage of labour, about the time that the water-bladder appears and ruptures, the cow's os or cervix (neck of womb) should have a diameter of at least 5 inches, allowing the fist to move round freely. Later on, when the fœtal parts complete the dilatation, the constriction caused by the os disappears altogether, and the vagina and uterus form one large cavity.

Traction.—By traction is meant the application of force to extract the fœtus. As a rule, the force applied is the strength of three or four men pulling steadily, strongly, and simultaneously on ropes attached to the head and feet; for the mare, six is a good, safe, and controllable number. These numbers should rarely be exceeded, except in some of the posterior presentations. We have already remarked that assistants should be thoroughly under the control of the operator. If little or no progress is made, there is generally something radically wrong with the position of the foal or calf, and the traction should cease until a further examination has been made. It may happen that the fœtus is coming all right, but the maternal parts are dry and contracted or imperfectly dilated. Again, insufficient help may be available, and the fœtus must perforce be delivered by the efforts of two men. In order to make the best use of their strength, the animal, unless recumbent, should be cast or induced to lie down; the men sit facing her hind quarters, against which their feet are firmly implanted, pulling at the same time on cords attached, if possible, above the knees or hocks. Needless to say, these cords must be strong. More purchase is obtained by tying a cross-stick to the cord close to the vulva, such as a piece of broom-shank 1 to 1½ feet in length. Mechanical contrivances are very useful in certain circumstances, when assistants are few in number and powerful traction is required; nevertheless they are capable of great abuse. We shall mention only the lever and pulleys. The *lever* is a pole about three yards long, one end of which is used as a fulcrum in a hole in the ground, or against a stake, post, door, or other fixed object. Cords connected with the fœtus are attached to the pole a certain distance from the lower end, say two feet, according to the direction of the traction. Considerable power is obtained by manipulating the upper end of the lever. It is obvious that this method has the advantage of being simple and easily controlled. It is also efficient. A great deal of force, more than with the lever, may be obtained by the employment of a set of light pulleys mounted on ball bearings. This appliance, although excellent for certain purposes, possesses the disadvantage of not being readily procurable, nor can its use by unskilled persons be recommended on account of the danger of rupturing the dam. There is no doubt that good *calving ropes* or "cords" are the simplest and most useful means of traction. Not only do they take up very little room in the passage and womb, but, being flexible, they seldom or never chafe the mother, the fœtus, or the arm of the operator; and they may be pulled in any desired direction. Again, if the cord should happen to slip, no harm results; but slipping may be prevented by first tearing away the membranes and maintaining a constant slight pull on the cord, even when it is not being used to extract the fœtus. No cord should be larger than necessary for the purpose for which it is required; a small cord is less likely to slip, and it takes up less room. Although any soft, clean rope may have to be utilized, special cords are highly desirable, if only to avoid the presence of knots in the birth canal. They should be at least four in number, six if possible, soft with the strands not too tightly twisted, and made of cotton, manilla hemp, or part cotton and part hemp. Cotton ropes are to be recommended owing to their softness and flexibility. A very useful pattern for practically all purposes has a spliced loop at one end through which the free end is passed to form an ordinary slip-noose, thus preventing the formation of an objectionable knot. Some cords have a running-noose at one end and a large loop for the hand at the other. In place of the loop, a cross-bar of wood may be attached, both to distinguish the rope and to obtain a better hold. The same purpose is attained by including wisps of straw at intervals in a turn of the rope. A good outfit should include one or two such ropes ½ inch in diameter, two or three ⅜ths of an inch, and one ¼ inch, each about 5 feet long. The thick ropes are suitable for severe traction, the thin ones for the lower jaw, while the remainder may be termed general purposes ropes for securing the limbs and certain parts of the body. A metal ring, instead of a spliced loop, is sometimes fitted on one end of the thin rope, but it possesses no advantage; on the contrary, it is more liable to slip and to injure the soft tissues. Cords are generally attached to the pasterns of the foal, the fetlocks of the calf, and the lower jaw of either animal. Stronger cords should, however, be applied above the knees or hocks as soon as the fœtus is sufficiently advanced, in order to prevent the fetlocks being torn through, or the toes being pulled off. An ordinary halter can only be adjusted when the head is close to the vulva, or actually outside the body. If the head is back in the passage, and the lower jaw threatens to give way from the excessive traction exerted upon it, the best plan is to pass the middle of a rope over the poll, bring the ends outside, and twist them until the loop is drawn tight round the throat. As the head advances, however, the nose tends to drop to one side; hence it is advisable to keep the hand alongside the head, and to apply a half-hitch to the lower jaw as it approaches the vulva. Attaching a running-noose to a foot lying far back in the vagina or uterus is not always an easy matter on account of the cramped space, the membranes of the young animal, and the straining of the mother. The procedure usually adopted is to slip the noose a short distance over the fingers and thumb, taking care to maintain a slight pull on the cord with the other hand; after reaching the foot, the fingers are bent, and a gentle pull causes the noose to slip over the foot. Even this simple manœuvre requires practice. Sometimes it happens that the foot is beyond reach, and the cord must be passed round the limb higher up, as described in knee and tarsal flexion (Figs. 330 and 336). For this purpose an instrument called a *porte-cord* or cord-carrier is often useful to hold the cord in position while it is being grasped from the other side of the limb. It consists of a steel rod with an eye in the end through which the looped end of the cord is passed; the other end of the cord is held in the hand outside the vulva. When the looped end has been secured, the porte-cord is withdrawn, the free end is threaded through the loop brought outside the body, and the running-noose formed in this way is slipped up round the limb. The instrument may be made in the form of a blunt hook with an eye near the point and a shaft as long as the arm, thus fulfilling the threefold purpose of a blunt hook, a cord-carrier, and a repeller. A straight porte-cord is sometimes used to repel the hind limbs.

Amputation of the Head and Limbs.—Not infrequently, simple measures of extraction fail, and certain parts of the fœtus require to be removed, either within or without the mother, in order to reduce its size and to obtain room for turning and other manipulative movements. These embryotomy operations, as they are called, have for their object the saving of the mother at the expense of the young animal; the latter, however, is generally dead or in a dying condition. It need hardly be mentioned that the amputation should not be delayed until the dam or the operator has become exhausted. In every case the part to be removed should be brought forward as far as possible, while the remainder of the fœtus is pushed well back into the uterus, and kept there either with the hand or the crutch. In this way extension and counter-extension are practised to an equal extent, and the risk of injury to the passage and womb is minimized. The injection of large quantities of lubricative fluids also assists the operation. It should be remembered that the skin is tough and offers the greatest resistance to dismemberment; so that particular care should be directed to its division and complete separation all round the leg, including the upper portion close to the body. The rule is to save as much skin as possible, and to tie or stitch the flaps in order that they may cover any portions of exposed bone. The thin cord attached to the flaps is brought outside the vulva, and is available for traction. A *fore limb* is amputated as follows: Use a hooked knife with a spring blade concealed in the handle, which is provided with an eye for the attachment of a cord to the wrist; keep skin tense by pulling on a rope attached to the fetlock or pastern; carry the knife high up over the shoulder-blade, and cut the skin down outside of limb its whole length to the fetlock; detach skin carefully all round limb in an upward direction from fetlock to shoulder as far as the hand can reach by means of the fingers and a skinning spatula; with the fingers tear away the muscles attaching limb to chest-wall, and divide them, if necessary, with the knife; lastly, make a circular incision through the skin all round the fetlock just above the rope. The leg is now ready to come away, and strong traction is applied to ropes round fetlock and just above knee. While assistants are pulling on these ropes, the operator's hand, or the crutch, is pressed firmly against the breast-bone. If this procedure is adopted, two or three men suffice to jerk away the limb with the shoulder-blade attached. A thin cord is then fastened to the skin flaps and left hanging outside the body. The next step is to pull on the cords attached to the head and other fore leg. If the latter requires to be removed, the head should first be repelled. Amputation of a *hind limb* is more difficult; the muscles and skin are stronger, and the skin is less easily separated than in the case of the fore extremity. Proceed in the same manner, commencing the incision through skin above the hip, or as high up as possible, and terminating at hock. Separate skin all round with spatula; divide the muscles both inside and outside the thigh; attach a second strong rope above the hock; and jerk limb away with four or five men on the ropes. More often, removal of a hind limb is required in breech presentations (Fig. 337), when the leg is completely retained under the fœtus and pointing away from the vulva. Here the skin is cut through deeply from the neighbourhood of the stifle, across the hip-joint, as far as the rump. The muscles of thigh are then divided, the hip-joint cut into, and the head of the femur or thigh-bone liberated and secured by a cord on which powerful traction is exerted. Meanwhile the operator completes the skinning process all round the leg nearly to the hock, where the skin is cut through in a circular manner, and the flap afterwards carefully tied with cord to cover the bone. The leg is thus drawn out thigh foremost with the skin still attached below the hock-joint. Needless to say, the operation is a somewhat formidable one, and should only be carried out by an expert. Amputation of the *head*, or decapitation, may be necessary in presentations such as Figs. 330 and 331 (pp. 1059, 1060).

Difficult Labour in the Ewe, Goat, Sow, Bitch, and Cat.—The general principles which have been laid down for the mare and cow apply to the smaller animals. It is true that wide differences exist in the management and habits of the latter, and in the circumstances under which they come in labour, while their comparatively small size compels the surgeon to modify his methods and to rely mainly on his hands and fingers, which are, unquestionably, the best and safest instruments. Nevertheless, the unnatural presentations already described are common to all species; and the indications for their treatment are essentially the same.

Ewes and goats may be classed together. The shepherd will be able to exercise better supervision if those ewes which are likely to yean first are kept separate from the others. Whenever circumstances permit, the lambing pens should be situated near a house or shed in which a good fire is kept going; this assures a constant supply of hot water, and the heat will help to revive exhausted ewes and lambs. Warm drinks, such as gruel, beer, etc., may also be prepared. The shed may also contain a bench on which ewes with unnatural presentations may conveniently be placed. Needless to say, the pens should be clean, free from infection of any kind, and properly constructed so as to afford adequate protection in bad weather. Most shepherds have to rely on their own unaided exertions and experience, and many become expert in saving both fœtus and dam. It is also the case that the conditions under which they have to work are often far from ideal, and call for the exercise of much patience, perseverance, and endurance. They should, however, never neglect to pare and file the finger-nails, and wash and disinfect the hands (as well as cords, hooks, etc., if used) before, during, and after the handling of each ewe. The precaution is all the more necessary in the case of dead and decomposing lambs, and when septic metritis is prevalent in the flock; for infection is very often conveyed from animal to animal, and is the cause of considerable annual loss to flock-masters. The shepherd would do well to provide himself with: (1) Plenty of pure lard with which to lubricate the passage and hands; (2) soap, hot water, and disinfectant—an ordinary coal-tar dip in weak solution answers the purpose for the hands and external parts of the ewe; (3) a few small clean cords, two short small hooks (one sharp, the other blunt), and a useful knife of a pattern to which he is accustomed—all instruments to be boiled after use; (4) a pint brass syringe fitted with one or two lengths of good thick rubber tubing for washing out the womb if the lamb is putrid, or injecting lubricants when the maternal passage becomes dry and swollen. The rubber tubing should be slipped over the wooden nozzle of the syringe, but it is well to remember that only the best rubber will stand the necessary boiling, without which the injection will do more harm than good. Ewes which are restless, isolate themselves, and strain at intervals for some hours should be watched, but premature interference is undesirable, unless it is evident that there is something wrong. Although birth may require several hours, as with the cow, and time is required for the birth canal to dilate, there is no harm in inserting the fingers, or the whole hand in aged, roomy animals, in order to ascertain the nature of the presentation. The lamb should come head and fore feet, or hind legs and tail first, all other positions being unnatural. In protracted labour the ewe often lies down after a time, when it is an easy matter to place straw under the hind quarters. In the standing posture she may be tied in a corner between two hurdles with the fore feet in a hole in the ground. In exceptional cases it may be advisable to administer a sedative draught consisting of a full tablespoonful of laudanum in half a pint of warm gruel. If the patient becomes exhausted, a little warm beer or whisky may be given with advantage, but in the majority of instances stimulants are best given after the birth of the lamb, not during a difficult labour. This remark applies to all the domestic animals. When it becomes necessary to extract the lamb, care must be taken to place it in a natural position before employing much force. But the retention of one fore leg need not delay delivery. Cord the head and other fore foot, pull them upwards and forwards towards the tail, and press the bent limb close against the chest of the fœtus. Unless in roomy, old animals, retention of both fore limbs (Fig. 330) calls for repulsion of the head after securing it with a cord or blunt hook. This brings a leg into the hand and finally into the passage. Even when the head is outside the body and swollen, the lamb is frequently born showing some signs of life; and it is remarkable how quickly it recovers. Nevertheless, with the fore legs missing, the ewe exhausted, or the lamb dead, amputate head without delay, as in Figs. 330 and 331. Pushing back the stump then enables the fore legs to be reached. Amputation of the latter is seldom required in the ewe. The frequency with which twin lambs advance simultaneously into the pelvis should be borne in mind. One lamb should, of course, be repelled and the other brought forward. Monsters appear to be rather more common in ewes than in the cow.

Sows seldom require assistance during parturition; the little pigs are generally smaller than the maternal pelvis, so that birth takes place quite easily. In the anterior presentation it is not uncommon for the fore limbs to be retained—bent back—under the body of the fœtus; yet, as long as the head is straight and able to pass through the pelvic inlet, no trouble arises. The procedure in difficult labour in the sow resembles that adopted for the cow and bitch. Unlike the calf, however, the short thick neck of the pig is very seldom deviated (Fig. 332). The most difficult proposition, as in the bitch, is a dead pig lying far back in the uterus, especially if the labour pains are exhausted. The surgical treatment of such cases includes the raising of the hind quarters in order to fill the uterus with a quantity of warm water containing a little boracic acid; the hind parts are then lowered and the abdomen vigorously manipulated so as to press the fœtus back towards the pelvis. In any malpresentation use hooks and forceps very cautiously, if at all. As in other multiparous animals, the head is the chief obstacle to delivery; the short limbs, fore or hind, seldom give rise to serious dystocia.

Bitches and Cats.—While all breeds are subject to dystocia, the short-nosed breeds of dogs with large dome-shaped heads, and well-bred Persian cats, are most liable. Like the sow, the head is most likely to cause obstruction to birth. Whereas the terrier pup's long, low head acts like a wedge in dilating the birth canal, the blocky, upright head of the Blenheim, for example, not infrequently sticks at the pelvic entrance or in the passage. Pugs, bulldogs, Japs, King Charles and similar breeds suffer to an equal extent. As in other animals, there are two natural presentations of the puppy and kitten; namely, nose and two fore feet, or tail and hind legs first. When coming anteriorly, however, it is not uncommon for one or both fore legs to be bent back under the body of the fœtus without material obstruction to birth. Difficult labour with small, as well as large, animals may be due to the mother or the fœtus, occasionally to both. One of the commonest maternal causes in the bitch is a weakness, or want of expulsive power, in the womb, to which the term "uterine inertia" is applied. Pampering and lack of sufficient exercise are among the factors which give rise to it. This serious condition must be promptly and vigorously dealt with if the life of the mother is to be saved. The aim of the surgeon is to stimulate the natural contractions of the uterine walls by means of heat, massage, warm douches, and, in the event of the puppy being reached, by exercising gentle but steady and continuous traction upon it. Certain drugs, such as pituitrin and ergot, which act directly upon the uterine muscle, are also indicated. The worst cases are those in which the fœtus, one or more, is dead and lying beyond reach towards the extremity of the uterine horn. When this contretemps occurs, the retained puppy undergoes rapid decomposition, and the mother, unless relieved, soon succumbs to septic poisoning (see "Metritis"). Various conditions give rise to fœtal dystocia, of which the following are the chief: (1) The pup is too large to pass through the pelvic canal. As a rule the bitch has been lined by a dog of a much larger breed; but it sometimes happens that the disparity in size is due to a small litter, consisting of one, two, or at most three puppies. Naturally these attain a larger size than in multiple pregnancies. (2) Two fœtuses approach the pelvic inlet simultaneously, blocking the entrance to the passage. This accident, it will be remembered, occurs rather frequently in twin lambs, and to a less extent in twin foals and calves. (3) A malpresentation, or a monster, obstructs delivery.

Dog-owners and dog-lovers naturally wish to know when and how to give assistance in what, at the outset, appears to be a normal parturition. If they cannot consult a professional man, they should pay particular attention to the duration of the labour and the strength of the patient. Speaking generally, when straining continues for some hours and no progress is made, either with the first fœtus or with those which follow, no time should be lost in placing the bitch on the table in the raised dorsal or lateral position, that is, on the back or side. With antiseptic precautions the finger is introduced into the vagina, while the abdomen is manipulated with the other hand, and the puppy pressed back towards the pelvis. At the same time the lips of the vulva may be drawn apart by an assistant, or a vaginal speculum may be inserted. If the young animal can be felt in the passage, continued manipulation with the finger and lowering the hind quarters may in time effect its removal. But a long button-hook, a pair of good forceps, or a wire loop may be needed to secure the presented parts and exercise gentle and continuous traction upon them. Much time and patience may be necessary before these efforts are successful. Yet instruments often prove dangerous weapons in unskilled hands; and when the pup is still in the uterus their use should be discouraged. From the foregoing remarks it will be gathered that the chief thing is to secure and deliver the head, supposing the fœtus is presenting anteriorly. In all malpositions much assistance is obtained by the intelligent manipulation of the head through the abdominal wall; but too much force should never be exerted on any of the extremities. Too often, powerful or jerky traction causes the fœtus to become broken up; bits of the puppy come away with the forceps, while the remainder is left behind to undergo putrefaction, and obstruct delivery of those still within the womb. Birth is also facilitated by the free use of lard or boracic ointment for the double purpose of protecting the maternal passage and lubricating the finger and vagina. The uterus, as in the sow, may be filled with warm boracic solution, which serves to excite uterine action and force the pup in the right direction. The hind legs should be raised during the injection, and afterwards lowered. In carrying out these manipulations, especial care should be taken to avoid wounding the mucous membrane of the vagina and uterus, owing to the great danger of metritis and septic poisoning supervening in the bitch. Injuries are easily produced by forceps, hooks, the finger-nails, or the sharp projecting bones of a broken-up fœtus. The failure of simple measures in serious cases of dystocia calls for the performance of one or other of the operations known as Cæsarean section, and excision of the uterus. But these operations, to be successful, must be performed in good time before the pup (or puppies) has become putrid and the dam exhausted. In both, the patient is chloroformed, and the uterus is exposed through an incision in the abdomen. In Cæsarean section, however, which has the advantage of conserving the breeding powers of the bitch and cat, the opening made in the uterus for the removal of its contents is afterwards stitched up, and the organ is returned into the abdominal cavity. As might be imagined, the operation is much less successful than the more drastic procedure of excision of the entire uterus and ovaries, which gives a good percentage of recoveries.

Inversion of the Uterus. Prolapse of the Womb.—These names are applied to a common and dreaded accident in which the womb is turned inside out immediately or shortly after a full-term birth, seldom after abortion. All animals are liable to inversion, but the cow is the most frequent sufferer, followed somewhat closely by the ewe. Occurring occasionally in the mare, it is comparatively uncommon in sows and bitches, although we have met with more cases in sows than mares. Prolapse of the vagina may be mistaken for the womb by the uninitiated, especially in small animals like the bitch (see "Inversion of Vagina"). In the mare and cow the return of the uterus is accomplished with great difficulty owing to the severe and continued straining, and the weight of the protruded viscus, which becomes much swollen and full of blood and fluid. The powerful expulsive efforts of the mare, and her susceptibility to inflammation of the womb and its covering (metro-peritonitis), often lead to a fatal result in this animal; whereas cows, ewes, and goats, subjected to early rational treatment, frequently recover. Yet any animal may die in a short time from exhaustion, or, later on, from inflammation, mortification, or septic poisoning. The mechanism by which the accident is brought about is not thoroughly understood, for it occurs under widely varied circumstances. It would appear that, whilst the uterus is in a weak relaxed state, its extremity suddenly becomes contracted and slips into the dilated portion immediately behind it, until the whole or the greater portion of the womb hangs outside the passage, with its red mucous lining forming the external covering. The telescoping process may be compared to turning the finger of a glove inside out. In the cow the "bed" usually comes down within four to six hours of calving; indeed it may follow the calf almost immediately, or its appearance may be delayed any time up to the forty-eighth hour. Late cases, however, are rare, and are mostly preceded by early partial inversion in the vaginal passage, followed by complete inversion after a certain time. As in woman, it is highly probable that the process begins at, or very shortly after, birth; although it may fail to attract attention until the final stage is reached. The accident depends mainly on three factors, a knowledge of which is essential from the point of view of prevention: in the *first* place, the neck of the womb must be wide open to enable the large organ to pass through—for this reason, inversion can only take place at parturition, or shortly after; *secondly*, strong expulsive efforts are necessary to force out the uterus — these depend, as a rule, on infection, injuries, and retention of the afterbirth, all of which excite irritation and straining; *thirdly*, the hind quarters are generally at a lower level. Too much importance cannot be attached to the relative positions of the fore and hind extremities. The cow is often a roomy animal, has bred several calves, and has been allowed to lie down within half an hour of birth on a sloping floor, frequently with her hind parts resting in the gutter. According to some observers, inversion is liable to follow a difficult parturition. On the contrary, the majority of cows and sheep give birth quite easily without assistance. That some cases do follow difficult labour, more especially in the mare in our experience, must be admitted. The accident may even occur during delivery. Thus, when the uterus is dry and tightly contracted on the fœtus, owing to the natural waters being long expelled, it is possible, by the exercise of excessive traction, to pull out both the organ and its contents; but such cases are of rare occurrence.

Symptoms in the Cow, Ewe, and Goat.—In the first stage, before anything appears at the vulva, the animal becomes very restless, exhibits uneasy movements of the hind feet and tail, and lies down and rises repeatedly. During the bearing-down pains, which increase in frequency and severity, a rounded, red, fleshy mass is seen between the lips of the vulva. So far the inversion is only partial, and prompt measures often succeed in preventing complete prolapse; but, as a rule, the animal is unattended, and the uterus is quickly protruded, and hangs down over the hocks. The neck of the organ is constricted, impeding the circulation, and the viscus thus becomes increasingly congested, swollen, and dark in colour, thickened and jelly-like from fluid passing out of the blood-vessels into and under the mucous tissue. The irritation produced by exposure to the air and contact with the floor, bedding, excretions, etc., soon causes inflammation of the mucous membrane and constant straining, which continues until the patient becomes exhausted and unable to rise. The surface of the womb is covered with large red projections, termed cotyledons, to which portions of the placental membranes are often attached. These cotyledons readily bleed when handled, but the hæmorrhage is never profuse or dangerous. We have never yet encountered a case of "flooding" in the lower animals. Furthermore, the unprotected organ is frequently injured by the animal's feet, the ground in lying, rubbing against the wall or side of the stall, the hands of attendants, and even by the bites of dogs; it also becomes covered with filth. In these ways the delicate covering is lacerated and torn, and complete rupture may take place. Mortification (gangrene) may also follow prolonged exposure and injury, especially when the accident recurs. This complication, which is always fatal, is met with more commonly in the ewe; for powerful straining efforts, following the natural expulsion of the lamb and membranes, may cause the whole uterus to again protrude after it has been successfully replaced.

Prevention and Treatment (Cow, Ewe, Goat).—*Prevention* consists in keeping the dam on her feet and under observation for a short time after parturition. The control of excessive straining, the elevation, if necessary, of the hind parts, the avoidance of injury to, or infection of, the genital passages from the hands or instruments of attendants during delivery, are also important preventive measures which should never be neglected. Nor should too much traction be exerted on the fœtal membranes (afterbirth) in cases of retention. Animals which have once suffered from inversion are generally considered to be liable to a recurrence at a subsequent parturition; but, according to our observations, they may be bred from with impunity, provided ordinary precautions are observed.

Treatment, needless to say, should be commenced immediately in order to avoid a fatal termination; for the longer the uterus is outside the body and allowed to hang down, the more swollen it becomes, and the greater the difficulty experienced in returning it. Often, we have marvelled at the neglect of the most elementary common-sense precautions. First aid should be directed to cleansing the viscus with warm water, or milk and water, and suspending it with a clean sheet held by two assistants, one on each side of the cow, who should endeavour to keep the mass level with, or even higher than, the vulva. In the first stage, before the inversion has passed much beyond the external orifice, the hands and arms should be washed and disinfected, and the fist, covered with a soft cloth, placed against the extremity of the mass, which is pressed back as far as possible into the vagina. The hand is kept in position until the arrival of veterinary assistance, while every means should be adopted to check the straining. The standing posture is undoubtedly best. Elevate the hind quarters one foot or more by filling up the channel behind the stall, and spreading a thick layer of short litter over the rear of the standing. When the cow is in a box, tie her up short, and either make a hole for the fore feet or raise the hind ones with straw, etc. In order to keep the hind feet on the heap, battens, bundles of straw, or similar material, may be placed on each side of the animal. The raised position, it is scarcely necessary to point out, takes advantage of the force of gravity, throws the weight forward, and lessens the power to strain. For sheep, two hurdles may be placed in the form of a V, the head being tied in the corner of the hurdles, and a hole made for the fore feet. Too much importance cannot be attached to the relative position of the fore and hind extremities in all species. The ewe, or any other animal, may be placed on her back. To a large cow (or mare), one to two wineglassfuls of laudanum, or one to two ounces of chloral hydrate, may also be given with advantage as a sedative; the latter should be dissolved in a quart of tepid water to which a little treacle or gruel is added; the laudanum is readily administered in a pint of cold water.[1] Straining may also be checked by pinching the back, or by tying a soft rope loosely round the chest and tightening it up with a stick. Excessive pressure, however, will cause the cow to lie down. The uterus having by this time been thoroughly washed and cleansed, a continuous stream of cold water may be applied. The veterinary surgeon then proceeds to remove the membranes, empties the bladder at once or later on, and makes a careful examination of the womb for injuries, stitching wounds if they require it. The latter procedure is, however, seldom necessary. When the cow is recumbent, she should be placed on her right side with straw under the hind quarters, or ropes may be attached above the hocks and passed over a beam or through pulleys, especially if the animal is turned on her back. The next important step is to reduce the size of the uterus by squeezing out the greater portion of the fluid and blood which it contains. This is accomplished by twisting the ends of the suspensory sheet and pulling in opposite directions; or a cloth may be folded over the organ and a long, broad bandage tightly and evenly applied over the cloth from the extremity as far forward as the vulva. Pressure and kneading with the hands is also of great assistance, but scarification of the mucous membrane should not be lightly undertaken. During these manipulations the doughy mass should be continually moistened and cleansed with a mild astringent and antiseptic solution; a one per cent solution of alum in cold or hot water can be recommended, best results being obtained by using cold and hot applications alternately. The uterus is now ready to return to its natural position. In simple cases this is easily accomplished, as already indicated, by placing the fist against the most dependent part, which has been raised level with the vulva, and pressing back the protruded mass during the intervals of straining, taking care to maintain sufficient pressure during the expulsive efforts to prevent further inversion taking place. When the uterus enters the passage, one hand replaces the other, the cloth is removed by a twisting movement, and the organ is finally straightened out in the abdominal cavity by introducing the arm to its full length, and leaving it in position for fully ten minutes until the straining has abated. Unfortunately, the whole uterus is generally found inverted, when this simple method of replacement is inapplicable. Here the surgeon begins with the portion nearest the vulva, returning the suspended viscus by degrees, until, after laborious work, the greater part has been pushed back into its natural cavity. The fist, or a bulbous wooden instrument, is now used, as before. Finally, the womb is filled with a warm, non-irritating antiseptic fluid, *e.g.* ¾ per cent carbolic or creosol solution, which not only cleanses, disinfects, and straightens out the organ, but stimulates its contractions and consequent reduction in size, on which so much depends. Contraction of the whole reproductive apparatus is also assisted by allowing the calf or other young animal to suck. The operation is completed by allowing most of the injected fluid to be expelled naturally, after which the remainder is siphoned off, and a sedative antiseptic pessary may be left in the empty uterus. Some means of *retention* is now generally adopted in order to prevent a recurrence of the accident, although it should be remembered that complete replacement of the clean, uninjured uterus is the best safeguard. The insertion of a champagne bottle or pig's bladder is an old method of bringing pressure to bear on the "os" or neck of the womb; a stick, fixed in the neck of the bottle, protrudes from the vulva and is tied to a surcingle, or, more commonly, to stitches in the vulva or to a truss. But the pessary, as it is called, tends to irritate the parts and to excite straining, hence we have long since discontinued its use. A less objectionable method, and one frequently employed, is to pass three stitches of waxed cord tape, or wire, deeply through the lips of the vulva, taking care to leave the lower portion unstitched for the passage of urine. The stitches, however, are liable to tear out and cause ugly wounds during the straining efforts, and for this reason the cord or tape may with advantage be tied on each side to pieces of solid rubber tubing, which can be easily kept clean. Wire sutures, being non-absorbent, are to be recommended, provided the ends of the horizontal pieces which traverse the vulva are long enough to enable them to be bent round with pliers to form rings or hooks through which a vertical wire pin is inserted on each side, and clamped with forceps. This simple bolting arrangement enables the stitches to withstand considerable pressure. The well-known West's clamp, of which small sizes are made for sheep and other animals, answers the same purpose. In the ewe it is a good and common plan to tie a lock of wool over the external opening. Some form of truss should always be applied, with or without the insertion of stitches. Whilst advocating the double precaution of stitching and the application of a truss, we would point out that all mechanical appliances must needs fail when the animal is allowed to strain violently and lower her hind quarters. For the truss no special apparatus is required. Take a full-length plough line, or a clothes line not less than 25 feet long; place the middle of the rope over the back a little behind the withers, bring the ends down on each side of the chest, and tie in a single knot below; then pass the ends forward between the fore legs, tie a single knot at the brisket or lower part of the neck, and another at the top of the neck, thus making a collar of the rope. Now carry each rope back along the spine, take a turn round the first part applied to the chest, and, standing behind the cow, cross and recross the ropes. A single knot may now be made below the tail, and another below the vulva, but a better plan is to apply a special loop or knot, for example, a simple figure-of-eight knot made flat and broad to cover the vulvar aperture. The truss iron is an alternative method much in vogue. Each rope is next passed between the hind legs on each side of the udder and carried forward and upward to the loins, where they are finally tied together. It will be readily understood that the truss requires frequent tightening and adjustment, owing to the slackening and displacement of the ropes when the animal lies down. To tighten the truss commence with the first portion round the chest, on the adjustment of which the animal's ability to strain greatly depends. The *truss iron* is a V-shaped instrument, applied to the vulva, which may be made by any blacksmith. The base of the V is uppermost, each arm being provided with a ring through which the truss rope is passed. Both ropes are then threaded through a larger ring situated at the apex of the triangle placed just below the vulva. The French pattern is also easily made and very ingenious, consisting of steel wire jointed in the centre, and designed to constrict and pinch the lips of the aperture without injury or inconvenience to the patient.

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[1] For dose for ewe see "Inversion of Vagina."

The *subsequent treatment* varies according to the symptoms presented by each individual case. Should the cow strain a good deal after the operation, a second and even a third dose of sedative medicine may be administered; on the other hand, when there is much weakness, exhaustion, or collapse, alcoholic stimulants are indicated. As a rule a purgative is given, followed by a little fever medicine, but complications require special handling on the part of the veterinary attendant. On the second day we have found it advisable to repeat the washing-out and disinfection of the uterus. Although this procedure is not always necessary, and necessitates the removal of the stitches, it will be found to give a larger percentage of recoveries. There is less chance of septic poisoning and inflammation of the womb supervening (see "Metritis"). The animal should, of course, be kept quiet and made as comfortable as possible, the surroundings should be clean, and the external parts frequently rinsed with an antiseptic. The hind quarters may be gradually lowered after the second day. In a short time the cow is removed to a loose-box with a good bed, and given a little gentle exercise. In favourable cases the animal is little, if any, the worse for the accident, and the appetite and secretion of milk quickly return. But injuries and septic complications, which do not prove fatal, cause loss of milk and condition, a discharge from the vagina, and more or less sterility. The cow goes over repeatedly to the bull. "How long may the uterus be out and yet be successfully returned?" The question is often raised in regard to the cow and mare. The answer is: "Four or five hours; some cows, but very few mares, recover after prolonged exposures up to twelve hours."

Inversion in the Mare.—Inversion is less common in the mare, but considerably more dangerous and more difficult to remedy than in ruminants. In our experience it follows a wrong presentation more frequently than in the cow, although foaling may take place quite easily and naturally. Unlike the cow, the membranes are seldom attached to the inverted womb. The mare is very uneasy, paws with her fore feet, and may roll in great pain as in spasmodic colic. A few mares even attempt to kick or bite the prolapsed organ. Reduction is effected in the same way as in the cow, the chief difficulty being the control of the mare, especially in the case of young vigorous animals. The twitch, rope hobbles, chloral or even chloroform, with considerable elevation of the hind quarters, may be required to prevent injury and to abate the violent expulsive efforts. Another plan is to open the windpipe and insert a tracheotomy tube; but this somewhat extreme measure is seldom required. Keep the mare on her feet if possible, but, when recumbent, tie the feet and keep the head down. Subsequently, in applying the truss, see that a pad is placed under the tail. Avoid sutures.

Inversion in the Sow, Bitch, and Cat.—Not uncommonly the inversion is incomplete, only a portion of the womb being turned inside out and protruding from the vulva. Few successful cases have been recorded in the sow. The great length and size of the two horns of the uterus, often as large as the vagina itself, make reduction very difficult; and the sow generally succumbs within twelve hours, unless amputation is promptly performed. One horn or branch of the uterus may be followed by the other, but the small size of the sow's vagina seldom permits the passage of both horns at one and the same time. Serious injury to the prolapsed organ also takes place, and the animal becomes rapidly prostrated. In bitches, it occasionally happens that one horn becomes inverted, imprisoning the puppies in the other horn, which remains in its natural position. One difficulty in the smaller species is the small size of the pelvis, which may admit only one or two fingers, requiring the use of a pestle or wooden pessary provided with a bulbous end like a constable's staff, or an ordinary tallow candle, in order to return the womb. Another is the trouble experienced in keeping the viscus in its place after reposition. Trusses are useless, but morphia is invaluable in the bitch, whilst the same principles of elevation, massage, and retention by means of stitches are observed as in the cow. The animal should be suspended by its hind legs on a bench or table ; the uterus, after return, is then filled with fluid, which is expelled by lowering the hind parts and pressing gently on the walls of the abdomen. Generally speaking, when both horns have been inverted for some time, or re-inverted, amputation should be resorted to. Yet the surgeon has certain advantages in dealing with small animals which he does not possess in the larger species. Not only are the expulsive efforts and the weight of the uterus less formidable obstacles, but the abdomen of small patients may be opened, and the uterus drawn into position and stitched to the side. Again, amputation is more successful than in the cow and mare.

Amputation of the Uterus.—This operation, like most of the above procedures, demands the services of a qualified surgeon ; yet instances may arise which require the intelligent stock-owner to rely on his own unaided efforts. Excision becomes necessary when it is impossible to return the womb, or to retain it in the abdomen after replacement ; also in cases of serious injury or gangrene, when grave risk would be incurred by pushing back the uterus. In the sow, as already indicated, amputation is often the only means of saving life. We have seen several mares recover, but the operation is always most serious in this animal. After thorough cleansing and disinfection of the womb and hind parts, a small incision is made in the viscus to admit the finger, in order to ascertain that no portion of the urinary bladder, or small intestine, is included in the cavity. These organs, if present, are easily returned into the abdomen. A straight sacking needle, or other instrument, threaded with a double cord or strong silk, the whole previously boiled, is then passed through the neck of the womb close to the vulva, taking care to avoid the opening into the bladder. The ends of the cord are tied tightly on each side, and then all round the neck of the tumour. This old method of ligation can be recommended as a safe procedure in any animal, owing to the fact that the ligature cannot slip, no bleeding can take place, whilst the stump soon sloughs away. The uterus is now cut off an inch or more below the ligature, the stump, after disinfection, is returned through the vagina, and the passage itself is syringed out for ten days or longer, until the discharge ceases.

Chloroform, morphia, or some other narcotic should be administered in this, as in all other painful operations. The uterus should also be reduced in size, and handled as described under the head of inversion. As soon as possible after the operation, the young animal should be returned to the dam to keep up the secretion of milk. Ruminants and pigs are fattened, although a good cow may remain in milk for a long time. Some animals become excited, or strain a good deal after amputation ; others, already weak and exhausted, show symptoms of collapse. Hence sedatives or stimulants may be required according to the case, with plenty of nourishing gruels and teas, milk and eggs, port wine, etc.

Inversion or Prolapse of the Vagina.—Whilst inversion of the vagina or passage may occur in any species, it is mainly confined to the cow, ewe, and bitch. These animals also suffer from this accident during advanced pregnancy, especially roomy fat cows and ewes which are closely confined during the winter months, warmly housed, and highly fed for the production of milk or early lambs. A relaxed, dilated condition of the vagina is thus induced which renders the subject liable to the more serious form of inversion which occurs after birth. Standing and lying on sloping floors is also a predisposing cause in the cow. The exciting cause is any irritation in the genital passages which excites straining and backward pressure on the pelvic cavity in which the vagina is lodged. Thus the vagina, like the uterus, may be turned inside out during attempts to expel the retained afterbirth, and the straining efforts due to the presence of infected wounds and inflammatory conditions of the uterus and the vagina itself. Not uncommonly inversion is a sequel to difficult birth, especially when the parts are dry and contracted and much force has been employed in the extraction of the fœtus.

Symptoms.—A rounded reddish swelling appears during the straining at the orifice of the vulva, which shows no tendency to disappear. On the contrary, it increases in size until the whole organ may be outside the body. In the mare and cow the mass may attain the size of a man's head. It undergoes the same changes as the uterus, becoming much swollen and inflamed, dark in colour from prolonged exposure, and injury to the delicate mucous covering is of frequent occurrence. The pressure on the urethra, or opening of the bladder, also leads to distension of the latter organ and difficulty in passing urine. The causes and symptoms therefore bear considerable resemblance to inversion of the uterus, but there are important differences which should be borne in mind. In the first place, vaginal prolapse is a comparatively mild accident; there is less straining, less general disturbance and danger to life. Secondly, the mucous membrane covering the vagina is quite smooth in recent cases, free from fœtal membranes (afterbirth), or the eminences for placental attachment peculiar to ruminants known as "cotyledons." Thirdly, when the whole of the passage is inverted, a distinct depression, or circular opening, is present at its inferior extremity, into which the finger may be passed into the neck of the uterus. Nor should the vagina be mistaken for the urinary bladder (see "Inversion of Bladder"), the cleansing or afterbirth, or a tumour adhering to the mucous membrane. A careful examination will enable the experienced layman, as well as the expert, to recognize the true nature of the protrusion. Veterinary surgeons are frequently summoned hurriedly to such cases, and must be prepared to deal with any accident or complication. Chronic inversion is also met with, and may prove very troublesome.

Prevention and treatment should follow the lines laid down for inversion of the cow's uterus. We have little to add to the directions already given. When the prolapse occurs at birth, it is washed and pushed back at once with little or no manipulation; but the swollen, inflamed, exposed mass must be thoroughly cleansed, disinfected, and its volume reduced, before it is returned by steady gentle pressure with the fingers and palms of the hands. If necessary, it may be painted with cocaine and a sedative given to the patient to keep her quiet. The operator must attend to his fingernails and remember that it is quite easy to push a finger through the inversion and rupture it. As the vagina slips back into its place, it should be followed by the hand to make sure that all the parts are properly straightened out. The vagina is retained by mechanical means, and precautions are taken to prevent recurrence, in the same way as the uterus. These include suturing or clamping the vulva, the application of a truss, raising the hind or lowering the fore parts, sedative applications like extract of belladonna, and other measures which lessen the animal's power or inclination to strain. The average dose of laudanum for the ewe is one tablespoonful (maximum $1\frac{1}{2}$) in half a pint of gruel, water, or rather less of linseed oil. It is also necessary to combat the uterine infection which frequently coexists and keeps up the irritation. For this reason an examination of the uterus should always be made in order to remove any fragments of afterbirth, and to wash out and disinfect the cavity.

Inversion of the Vagina in the Bitch.—Middle-aged and old animals are most subject to this accident, especially after parturition; but partial prolapse is not uncommon during heat (œstrum). At such times the animal's behaviour—rubbing, licking, and straining—draws attention to the presence of a rounded tumour projecting beyond the vulva. The vagina may even be pushed out before or during birth, interfering with the delivery of the puppies. In size, the protrusion varies from a small plum or pullet's egg to a large orange or child's head. Small and white at first, the colour changes with the length of exposure to air and dirt, becoming dark red or almost black. The condition is serious in brood bitches, for it is always liable to recur, and prevent conception when the bitch is mated. Apart from sterility, the constant irritation in old-standing and recurrent cases may give rise to ulceration, injury, and even mortification of the vagina, whilst there is generally some difficulty in the passage of urine. Furthermore, the mucous lining becomes dry and roughened, thickened and wrinkled, until the parts become almost unrecognizable, and impossible to retain in position after replacement. The fact that the vagina of the bitch is more likely to be mistaken for the uterus than in other animals should be borne in mind. Treatment is a simple matter when the freshly inverted organ is washed and promptly replaced, and the patient kept quiet, clean, and short of food. Even in neglected cases an attempt should be made to effect a cure by simple measures—bathing with hot, or hot and cold water, containing a little alum or Condy's fluid, lubricating with olive-oil or boric ointment, raising the hind parts, compressing and squeezing the tumour with the fingers, and, if necessary, injecting one grain of morphia under the skin to prevent present and after straining. With the same object the surface of the vagina, as mentioned above, is also painted with cocaine. Lastly, when the whole of the inversion has been returned and straightened out, the usual stitches are inserted deeply through the lips of the vulva. In bad cases, however, amputation is often the only resort. The operation, although less formidable, resembles amputation of the uterus, and it is performed for the same reasons, care being taken to avoid the opening for the passage of urine. Unfortunately, amputation renders the bitch useless for breeding purposes. In younger animals, therefore, an alternative method may be tried by the surgeon. This consists in opening the abdomen, and pulling gently on the uterus, to draw the vagina into its natural position. The uterus is then stitched to the side of the abdominal wall. A cure effected in this way possesses the great advantage of conserving the breeding powers of valuable animals.

Inversion or Prolapse of the Bladder.—This uncommon accident is met with mainly in the mare as the result of violent expulsive efforts during and after foaling. Somewhat rare cases occur in the bitch, sow, and cow; but we shall confine our remarks to the mare. In this animal the urethral opening is of large size and situated on the floor of the vagina a few inches from the vulva. Two fingers can easily be inserted through the opening into the bladder, which lies immediately beneath the vagina or passage. When inversion takes place the empty bladder is forced through the wide urethral opening, and turned inside out like the finger of a glove. The red mucous lining then forms the external covering, the orifice through which it has passed cannot be felt, whilst the ureters (tubes which convey the urine from the kidneys) can be seen opening, one on each side, near the neck of the bladder close to the vulva. Occasionally the accident occurs before foaling, when great care is required to prevent serious injury to, or rupture of, the bladder during birth. Although the inversion may not obstruct delivery to any extent, it undoubtedly complicates a wrong presentation of the foal. In one case which we attended, the bladder appeared outside the vulva 24 hours after parturition, during the efforts of the mare to expel a portion of cleansing from the womb. In appearance the mass is red, fleshy-looking, and somewhat pear-shaped, becoming in time much swollen, rough, and dark in colour or black from exposure to air and dirt, and interference with the circulation. In recent cases, however, the surface is quite smooth and fresh, and little of the bladder may be seen during the intervals of straining. A constant and characteristic symptom is the dribbling of urine from the mouths of the ureters. Seeing that no urine can collect within the bladder, it continues to trickle down the thighs, irritating the skin and removing the hair. The urine is often ejected in a considerable stream during the straining efforts, particularly when the bladder is touched with the fingers. The attendant or owner who bears these facts in mind need have no fear of mistaking the bladder for the cleansing, the uterus or vagina, or even for a vaginal tumour; but it is always advisable to insert the hand and trace the inversion as far as the urethral opening, from which it appears to arise. Although the condition is more dangerous than inversion of the vagina, recovery is the rule when the mass is returned without delay. A great deal depends upon the length of exposure, and the presence or absence of injuries and complications. Treatment consists in checking the straining and returning the organ, after thorough cleansing, through the urethral orifice. In the early stages this is not difficult, unless the bladder suddenly appears during foaling, and reappears immediately it is replaced in position. When this happens the mare should be turned sharply round, and cold water dashed over the loins. The twitch also serves to distract her attention until a dose of sedative medicine has had time to act. Inflammatory changes, with thickening of the bladder walls, call for gentle massage and firm pressure with the hands to reduce the swelling. Manipulation is also assisted by douching with hot and cold water alternately; a little common salt, alum, or boracic acid may be added to the water. Both to assist reduction and to prevent recurrence, the mare and cow are kept quiet with chloral hydrate, the bitch with morphia, the hind quarters being elevated, and the bladder, after return, filled with cold boracic or salt solution. When reduction is partly effected, we have found a metal catheter covered with rubber tubing a useful instrument with which to push back the remainder of the organ. After several days' exposure it may be necessary for the veterinary surgeon to cast and chloroform the mare. He may also have recourse to amputation by means of the ligature and knife when the bladder is torn or ruptured, or impossible to return or keep in position. The ligature is applied behind the orifices of the ureters; but the constant dribbling of urine which follows the operation is a great drawback.

Retention of the Fœtal Membranes, After-birth, or Cleansing.—The fœtal membranes or "cleansing" are generally shed a short time after birth. The manner in which this important natural act takes place requires some consideration in order to understand the changes which take place in disease. As soon as the umbilical cord connecting the fœtus with its membranes is ruptured, the blood supply is cut off, and the placenta shrivels up. Soon the uterine contractions (after-pains) recommence, the womb becomes progressively smaller, and the after-birth is gradually pushed out. The process varies in the different animals according to the attachment of the placenta. In the first place the reader should have a clear idea of what is meant by the *placenta*. Briefly, it is the arrangement by which the young animal is attached to the womb for purposes of nourishment and growth. It consists of two portions, maternal and fœtal, which are closely united. The fœtal placenta comprises a number of processes or projections on the chorion, the outermost of the three fœtal membranes, which is closely applied and moulded to the uterus. In other words, the strong, thick, vascular chorion carries the fœtal portion of the placenta. The maternal placenta, on the other hand, is represented by numerous pits or recesses in the uterine wall into which these processes are fitted. When we examine the cow and ewe, we find the mucous lining of the womb studded at intervals by large oval prominences, the maternal cotyledons, into which clumps of long, branched processes are inserted. The latter, called fœtal cotyledons, can be distinctly seen when the membranes are expelled. The placental attachment is obviously most intricate in ruminants, and it is confined to certain areas covered by the maternal and fœtal cotyledons. In the mare, however, the whole surface of the chorion is covered with short, red processes which fit into corresponding recesses all over the surface of the uterus. The simple placenta of the mare is thus easily separated, the cleansing following the foal in a few minutes. But the cow takes much longer to cleanse, often two or three hours or more. The explanation is that separation of the placenta in the cow takes place slowly owing to the intricate, and very intimate, connection between the maternal and fœtal cotyledons. To a certain extent, perhaps, this anatomical peculiarity explains why cows are far more subject to retention of the afterbirth than other animals. Against this theory is the fact that ewes, with the same placental attachment, are, comparatively speaking, seldom affected with the disease. In the bitch and other multiparous animals retention is quite uncommon, and is limited to the last set of envelopes. The envelopes or membranes appear along with, or immediately after, each fœtus.

We propose to describe this condition in the cow, and, later on, to point out certain differences or special features in other animals.

Retention of the Afterbirth in the Cow and Ewe.—This is one of the commonest diseases with which the country veterinary surgeon has to deal, for it attacks a large number of cows of all breeds and ages, especially in abortion-infected districts. Retention is chiefly responsible for the production of sterility, and various chronic diseases of the generative organs, which are the cause of much economic loss and disappointment to breeders and dairy farmers. The fact that many animals are not visibly affected in general health accounts for the natural, but unfortunate, tendency to leave the uterus, with its attached membranes, to take care of itself. It is true that milk secretion is diminished until the cleansing comes away and the subsequent discharge ceases; some cows lose condition; not a few go over to bull, or prove permanently barren; while a small number die from septic inflammation of the womb and blood poisoning. But, in the main, the immediate effects are trifling, and the remote effects are either imperfectly understood or ignored. The *causes* of retention are not always clear, although vastly important from the preventive point of view. Anything which lowers the tone of the system acts as a predisposing or contributory cause, *e.g.* weakness, debility, confinement, old age, exposure, chills, and travelling. It is well known that cows travelled long distances by rail and sea, and those which are taken from market to market, are liable to hold their cleansing. Again, anything which lowers the tone of the uterus predisposes to retention. Thus in twins and dropsy of the membranes, the weakened and dilated uterus is often powerless to contract, and so squeeze the maternal cotyledons and detach the chorion. This want of contractile power is spoken of as inertia. Aged cows, more often, suffer from retention, particularly in bad seasons and after a difficult calving. The actual or exciting cause is infection from many different organisms, including the abortion bacillus. Our own experience is that over 75 per cent of aborting cows fail to cleanse. Infection of the womb most often arises during (sometimes after) parturition from wounds inflicted by the calf, or the hands and instruments of the operator; infection from the abortion organism may occur at any time during pregnancy or during the act of service; while some writers are of opinion that infection, other than abortion, may in some cases be already present at time of service. Although easy calvers are by no means exempt, infection of the womb and consequent retention is more common in difficult births. In such cases two important factors appear to coexist—infection and inertia—or one may follow the other. The question naturally arises "How does infection act?" Unquestionably it gives rise to a mild metritis or inflammation of the mucous membrane of the uterus, with swelling and firm adhesion of the two portions of the placenta. Lastly, an uncommon cause of retained afterbirth is a twist or entanglement of the membranes round one or more of the maternal cotyledons.

Symptoms.—A portion of the membranes hangs from the vulva, sometimes reaching the hocks, or the ground, when the cow is standing; the remainder is attached to certain cotyledons in the uterus. The retention is thus only partial, some of the cotyledons having already "peeled." In the recumbent position only the umbilical cord may be seen, and even this is absent in those uncommon cases in which the afterbirth is completely retained. It is clear that the weight of the membranes outside the body exerts steady traction on the attached portion within the womb, and that the process of separation is assisted thereby. Unfortunately, the hanging portion may break off, the cow may tread on it, or, worse still, the dealer may cut it off—a practice which is followed by retraction of the stump within the passage, and which favours retention. During the twenty-four hours following a full-term birth, the membranes are fresh, slimy, and reddish in colour, containing little pockets or sacs filled with fluid; in abortion they have a sickly odour, and frequently they are dropsical. In both instances putrefaction is well established at the forty-eighth hour, the colour changes to a dirty grey, the odour is offensive, and an irritating, greyish or chocolate-coloured discharge makes its appearance. The veterinary surgeon is often consulted as to whether new purchases have cleansed. In doubtful cases he may require to introduce his hand into the back bowel (rectum), when the firm, unyielding mass can be distinctly felt in the dilated horn of the uterus. Seeing that the neck of the womb in full births does not contract to any extent until the third day, palpation through the vaginal passage also reveals an open "os." The aperture soon becomes too small to admit the hand, and masses of decomposing placenta are liable to become imprisoned within the uterus. When the cow or heifer has aborted, contraction of the os commences at an earlier stage, and earlier still when the uterus is empty and the membranes have been naturally expelled. The owner or attendant may, however, satisfy himself that the animal has not cleansed by observing the following local symptoms: uneasy movements of the hind quarters, kinking and switching of the tail, occasional straining, discoloration of the passage, fœtid odour, and the presence of a discharge. The latter may be absent, but the mucous lining, on parting the lips of the vulva, is seen to be swollen and discoloured, while the sense of smell is a good guide. General symptoms, with the exception of loss of milk, and sometimes loss of condition, are often looked for in vain. But the cow may be dull and off her feed, a little stiff and feverish, when she quickly recovers, or rapidly becomes worse and exhibits symptoms indicative of inflammation of the womb and blood-poisoning (see "Septic Metritis").

Prevention.—The up-to-date stock-owner cannot expect to effect any material reduction in the number of retained afterbirths unless he succeeds in stamping out contagious abortion. Yet he has it in his power to limit the amount of womb infection which gives rise to such dire results. In this connection the causes of the disease require careful consideration. Dry cows heavy in calf should be kept in fair condition, and provided with shelter in bad weather; the uterus should be healthy at time of service—admittedly, a difficult proposition; dairy cows housed during the winter should be let out to water, or exercised daily in a yard; the whole premises, particularly the calving boxes, should be kept very clean; and great care should be exercised in difficult parturitions in regard to the hands, finger-nails, ropes, etc., and also in the turning movements necessary to effect delivery of the calf. Injury to the genital passages, and infection from dirty hands and instruments, must be specially avoided in the case of twins or a dead fœtus. These precautions tend to keep the womb active and vigorous in order to expel the afterbirth.

Treatment has given rise to much controversy in the veterinary world. "Is it advisable to remove the membranes by hand?" If so, "When is the best time to perform the operation?" These are questions which can only be answered by the expert after making an internal examination of each individual cow. There is no fixed rule, for rational treatment depends on the circumstances of the case and the firmness of the attachment. In the majority of instances the membranes appear to do no harm for a few days, and it is here that differences arise as to the best procedure. Our practice is to *remove the afterbirth as soon as it can be taken away without upsetting the animal*, that is to say, as soon as slight traction and peeling the cotyledons with the thumb and fingers brings it away easily and completely. Occasionally this may be accomplished even before the twenty-fourth hour, more often on the second or third day, but oftener still on the fifth or sixth day. In our experience, the latter is frequently the best time, particularly in strong cows which have calved at full term. After the third or fourth day, it is true, a little patience may be required to dilate the os with the hand. Severe straining, hæmorrhage from the cotyledons, and tearing of the membranes are indications for delay. Yet the possibility, or probability, of inflammation or blood-poisoning supervening must always be borne in mind. Hence it is that in difficult births, decomposing fœtuses, general weakness, and dilated paralysed conditions of the uterus, professional opinion is unanimous in advocating early removal with repeated irrigation or douching of the womb. Energetic treatment, both surgical and medical, is required immediately the appetite begins to fail. This is the first danger-signal. Abortion after mid-term also calls for early separation of the membranes. In ewes, gentle traction (pulling on the membranes) is often successful within twenty-four hours of lambing. The process of separation is assisted by keeping the animal warm, manipulating the abdomen, and by the use of weak douches as in the cow. In all cases of retention the following measures can be recommended: (1) Douche the vagina twice daily with a very mild antiseptic solution, *e.g.* Condy's fluid, or a level tablespoonful of common table-salt to a gallon of warm water. The wooden nozzle of an ordinary quart brass enema-syringe should be made to plug, not screw, on to the syringe, and should be covered with rubber-tubing. Jeyes' fluid, cresol, and similar agents often burn the delicate mucous membrane, and excite severe straining. Two per cent solutions, however, are useful for disinfecting the hind parts of the cow, and the floor, walls, etc., of the box. (2) Roll up and knot the afterbirth ; or, better still, attach a short, heavy, smooth stick, or two flat pieces of wood. Twist up and pull daily without tearing or breaking the membranes. (3) Isolate the animal, and observe strict cleanliness. (4) Attend to nursing, keep warm and comfortable, and give laxative, cooling food. (5) Administer a purgative drench, as a rule, and follow, if desired, with a few cleansing powders. Drugs, however, are of little value in expelling the afterbirth ; their chief action is to lower temperature and to keep down infection. Hyposulphite of soda—2 ounce doses twice daily in a pint of water—is harmless, and sometimes beneficial. That old-fashioned remedy, sugar, may also be given in 1-pound doses for three or four days. (6) After removal or normal expulsion, the membranes should always be examined to see if they are complete. Sometimes a portion is broken off and remains in the uterus.

The introduction of lard, say two pounds, into the womb is said to assist removal next day. The practice appears to be common in Ireland. Lubricants, such as lard, olive-oil, or vaseline, especially when mixed with a suitable antiseptic, also serve to protect the irritated and inflamed mucous membrane of the vagina and uterus.

To obtain good results in retention, the veterinary surgeon should be given a free hand to watch the case and to complete the disinfection of the womb. He may require to pay several visits in order to carry out the *after-treatment*, but the latter is of great importance in the prevention of sterility. Too often, irrigation is limited to a single injection, with the result that the cow is difficult to get in calf, she aborts during the first few weeks, or she holds her cleansing a second time at the next calving. In conclusion, we would deprecate the practice, fortunately uncommon, of allowing cowmen to syringe the uterus, or handle the membranes within it. We have known serious accidents, even rupture, to occur in this way.

Retention of the Afterbirth in the Mare.—The simple placenta of the mare is, as we have seen, more easily and quickly separated than that of the cow. Retention is thus much less frequent than in ruminants. It is, however, much more serious. Total or complete retention is rare, owing to the fact that the thick, tough membrane, called the chorion, is attached all over the surface of the uterus, and the uterus cannot contract without loosening the chorion. Hence we usually find a large portion of the membranes hanging from the vulva. Occasionally the protruding portion is broken off, and a remnant is left in the extremity of the uterine horn which carried the foal, leading the attendant to suppose that the mare has cleansed. This is the most dangerous form of retention, as the smallest piece left behind rapidly decomposes and leads to septic inflammation of the womb and laminitis. Infection is apt to occur very quickly, often with little or no warning, through the large raw surface—practically the whole area of the uterus—which is available for the absorption of septic products. The causes and symptoms are much the same as those in the cow, but fever in the feet (laminitis or founder) is a frequent complication ; indeed, it may be the first thing noticed. It is imperative that *removal of the membranes should be effected not later than the sixth or eighth hour after foaling.* Some mares, it is true, will hold the afterbirth for a longer time with impunity. We have known more than one mare go twenty-four hours without harm ; but such cases are very exceptional, and it is a safe rule that the sixth hour ought not to be exceeded, whenever possible, in ordinary parturitions. Not uncommonly, dystocia (difficult birth) is followed by retention, when manual removal should be carried out immediately or very shortly after the delivery of the foal. In all cases, whether removed by hand or naturally expelled, the membranes should be carefully examined to ascertain if any portion has been broken off and left in the uterus. Manual removal is more easily accomplished than in the cow, the dark-coloured chorion being thick, strong, and capable of withstanding considerable traction. There is little fear of rupturing this membrane, and mere pulling on different portions of it is sometimes successful in bringing it away. More often it is necessary to insert the hand on the flat, using the fingers like a spatula or skinning knife, and working in a forward direction between the chorion and the uterine wall. The process of separation, which should be evenly and equally carried out all round the uterus, is analogous to skinning the limb of a foal or calf when its amputation is necessary to effect delivery. Much assistance is afforded by steady, firm traction with the other hand, and by the injection of fluids, both of which measures stimulate the natural contractions of the womb and bring the end of the affected horn within reach of the operator's hand. Complete removal at this point is the only critical stage in the operation. The after-treatment does not differ from that indicated for the cow ; but, whenever delay has taken place, it is wise to remove the mare's shoes, if this has not already been done previous to foaling, and watch her closely for symptoms of laminitis, particularly for sudden loss of milk, lack of interest in the foal, stiffness, etc. If the womb becomes inflamed and septic poisoning sets in, treat accordingly (see "Septic Metritis").

Retention of the Afterbirth in the Bitch and other Small Animals.—In the bitch and similar animals, which give birth to several young at a time, it is well to remember that the horns of the uterus are very long, the fœtuses are developed in each horn, and each fœtus is enveloped in its own set of membranes. One young animal is thus born independently of another, and a considerable interval may elapse between the different births. As a rule, the membranes or "placentæ" come away with each puppy, but it may happen that one placenta remains in the uterus until the next puppy is born, when both sets of membranes are expelled together, or one after the other. As already stated, retention is more frequent and dangerous in the case of the last placenta, although the accident is not at all common. Frequently it arises from protracted labour, apparently from a weakness or want of tone on the part of the uterus to effect the expulsion—a condition to which the useful term "inertia" is applied, and which may be due to want of sufficient exercise during pregnancy. When parturition sets in, labour may continue for twenty-four or even forty-eight hours, the uterine contractions which bring about expulsion may be practically abolished, and the mother more or less exhausted, especially when it has been necessary to extract the puppies. If the latter are dead, retention is more likely to occur, and infection of the uterus quickly takes place. It is a well-known fact that membranes or puppies, when retained in the uterus, rapidly decompose, micro-organisms invade the womb from the passage, and a serious, often fatal inflammation is set up, associated with septic poisoning. In this respect the bitch resembles the mare. Retention is less dangerous in the sow. It is often recommended to count the placentæ, but the liability of the bitch, sow, and other animals to eat the membranes should not be overlooked. Amongst the early symptoms which point to septic infection are: Rise in temperature, dull, miserable appearance, straining, and loss of appetite. The presence of a greenish-black or blood-stained, foul-smelling discharge is also significant. Other symptoms will be mentioned in dealing with septic metritis in the bitch. Before the abdomen becomes very tender to pressure and distended, it may be possible to feel the placenta through the abdominal wall, with the finger or fingers of the other hand in the vagina. Although manual removal is generally impossible, treatment is carried out on the same lines as in the larger animals. Needless to say, prompt and energetic measures must be adopted to save the patient's life. As in metritis, the uterus must be thoroughly flushed out with boiled water or sterile salt solution, taking care to use a double-channelled tube to prevent over-distension of the organ. This mechanical cleansing, which removes most if not all the putrid contents, is followed by the injection of a warm, mild, antiseptic solution, such as peroxide of hydrogen (1 in 100); chinosol (1 in 600 to 1000); potassium permanganate (1 in 400 or 500). Condy's fluid added to the water until it becomes a light port wine colour is quite effective. All fluid should be allowed to drain away naturally or siphoned off. The emptying of the uterus is assisted by manipulating the abdomen, and standing the patient upright on her hind legs. She should also be allowed to run about after the injection. The general treatment depends on the gravity of the case. Stimulants, such as frequent teaspoonful doses of brandy or whisky, nutrients, such as beef-tea, etc., and internal antiseptics like salicylate of soda or quinine may have to be administered in order to sustain the strength and counteract the effects of the blood-poisoning. Good nursing is, of course, a *sine qua non*.

Metritis, Inflammation of the Womb, Septic Metritis.—This serious, often fatal, disease affects all animals shortly after parturition or abortion; it is rarely seen at other times. The uterus (womb) becomes acutely inflamed from the entrance into the tissues of septic organisms, which gain access, as a rule, through a wound or abrasion in the mucous membrane lining the genital passage. As the disease is always accompanied by more or less septic (blood) poisoning, the term "septic metritis" is often applied. Several organisms, or groups of organisms, acting together appear to be the exciting cause; but their exact nature is of chief interest to the pathologist in the preparation of vaccines for purposes of prevention or cure. Prevention is, naturally, the main concern of the stock-owner, who should understand that he is dealing with a contagious disease, and have a clear conception of the factors which give rise to it. The *causes* are to be sought for in wounds of the mucous membrane; decomposing afterbirth, or dead and putrid fœtuses retained in the womb; weakness and exhaustion from exposure to cold and wet; dirty surroundings; and lastly, lowered resistance to infection from travelling by rail or sea and other hardships at the time of, or shortly after, parturition. Abortion is more likely to be followed by metritis than full-term births, for two reasons: (1) The uterus is already infected. (2) The afterbirth is more often retained. It should be remembered, however, that the causal organisms are generally introduced from without, chiefly by the soiled hands and ropes of attendants, but occasionally through the medium of contaminated floors and bedding. Even the syringe employed to douche the vagina of a diseased animal may convey the infection to others. Indeed the disease may be readily carried in various ways from one animal to another. In dealing with parturition difficulties we have already emphasized the need for thorough all-round cleanliness and disinfection before, during, and after labour. Sometimes metritis follows a normal birth when the maternal passages have been bruised or torn by the fœtal parts during delivery, or where the afterbirth has not been completely expelled. Yet it is well known that the rougher the handling the greater are the chances of infection. Thus metritis is always to be feared in cases where crude attempts have been made to extract the young animal in an improper position. Injuries, followed by inflammation, also occur in bringing the head round, or in extending a limb, unless the operator is careful to push the fœtus well back into the womb, exercises proper skill, and covers the foot with his hand. If parts of the fœtus require to be amputated, and the young creature removed in bits, the exposed ends of bones may scratch or tear the dam. Not infrequently, the bitch is injured by the forceps or hooks employed to extract the puppies. In the face of so many opportunities for infection the reader will marvel why so many animals escape; but a great deal depends upon the patient's condition and surroundings, as well as her susceptibility and species. A cow, for example, will stand more pulling about than a mare or bitch, or even a ewe; and if she has calved down in a comfortable box under good conditions, and her vital powers are not weakened by poor food, exposure, travelling, or disease, metritis seldom supervenes. Prevention is thus largely a question of good management, although it must be admitted that some animals readily succumb, while others, in similar circumstances, remain unaffected. The latter appear to possess a high degree of immunity. One of the commonest causes of metritis is retention of the placental membranes; these soon swarm with septic germs, whose poisons are absorbed into the blood. Again the attendant's hands may convey the disease. This is not uncommon during the busy lambing season, when the shepherd, working single-handed, is forced to handle both diseased and healthy ewes, with disastrous results. The lambing pens are also a source of danger to the healthy members of the flock. The latter, that is to say, all lambing ewes, should be removed without delay, and put in charge of another shepherd. As might be expected, ewes which lack adequate protection in bad weather prove less resistant. Another cause is "Falling down of the Womb" (see "Inversion of the Uterus"). Metritis is likely to ensue when the organ has been subjected to prolonged exposure, torn, or returned into the abdominal cavity along with dirt or fæcal matter.

The *symptoms* vary considerably according to the severity of the inflammation and the degree of septic poisoning. They appear, as a rule, between the second and fifth day after birth. All females become dull, weak, depressed and feverish; the appetite and secretion of milk rapidly fail, the udder and teats becoming cold and limp; uneasy movements of the tail and hind quarters, stiffness, pain, and severe straining are present almost from the outset; and a stinking, blood-stained, very irritating discharge issues from the vulva. Some subjects, like the cow, grind their teeth, moan or groan with the pain, while the majority assume the recumbent position and seem afraid to move. The pulse, too, is always very weak and rapid, the breathing quick and shallow, and the membranes of the eye and nostril assume a dirty-red or reddish-yellow colour. When these symptoms are observed within forty-eight hours of parturition, the prospects of recovery are very remote. Soon a fœtid diarrhœa sets in, the abdomen becomes tense and distended, and the patient staggers from weakness, rapidly loses condition, and acquires an anxious expression and most miserable appearance. In such cases, there is marked blood-poisoning, and death ensues in two or three days from exhaustion and heart failure. The discharge from the vulva is frequently dark-red or chocolate-coloured; but, while the passage is swollen, red, and discoloured, the external parts (vulvar labia) are curiously small, shrunken, and retracted, especially in the cow. In the less fatal forms of the disease, symptoms of serious illness may be delayed for several days. There is more local inflammation, tenderness, and swelling of the genital parts, including the vulva; but the signs of septic poisoning are less pronounced, with corresponding diminution in the amount of prostration and general weakness. In all cases a constant feature is distension of the uterus with putrid material, resembling in character the discharge already mentioned. When the symptoms are thus modified, and later in making their appearance, patients may live seven to ten days, and a fair percentage recover with prompt and energetic treatment. In both forms of metritis, severe and comparatively mild, the milk of the **mare** suddenly fails at an early stage, and she loses all interest in the foal. Laminitis is frequently seen during the first twenty-four or forty-eight hours. Infection occurs earlier than in the cow; so much so that metritis is generally established on the second day after foaling. The mare, also, shows a marked preference for the standing position, remaining more or less motionless with the back arched. If made to move she does so very stiffly. Occasionally she suffers from colicky pains, and she may perspire profusely. The **cow** behaves in a somewhat different fashion, lying a good deal, and sometimes refusing to rise. The prominent symptoms are: groaning, grinding of the teeth, sinking of the eyes in the orbits, tympany, and almost continuous straining. The prognosis, notwithstanding, is rather more favourable in cows than in other species. In some cases distinct improvement is noticed in a few hours. The **ewe** becomes weak and prostrated almost from the outset, the rumen (paunch) becomes distended with gas, and many sheep die. The **bitch** also strains and suffers from vomition; even water, of which she partakes greedily, is not retained. The discharge from the vulva is invariably dark, often a peculiar blackish-green colour, and, as in other animals, very acrid, irritating, and fœtid. The bitch also suffers from septic peritonitis due to the extension of the inflammation from the womb to the serous membrane lining the abdomen. When this complication is present, the abdomen becomes tense, distended, and very tender on pressure, while the pain and stiffness increase, and the puppies die from starvation if left on the mother. The bitch, it will be remembered, is very subject to septic poisoning. According to the virulence of the infection, death generally occurs in from one to four days. Experts agree that some hope of recovery may be entertained if the bitch survives the fourth or fifth day. A fatal complication, sometimes found on post-mortem, is ulceration or perforation of the uterus. This is probably the result of an injury during parturition inflicted by the forceps of the obstetrician, or the bones of a broken-up fœtus.

Prevention, Mortality, and Complications.—The importance of preventing such a fatal disease is obvious. The average mortality in the domesticated animals may be estimated at 60 per cent. Moreover, in non-fatal cases, not only is the patient weak and emaciated for a prolonged period, and lacking in milk for her offspring, but a chronic metritis frequently remains, which temporarily interferes with breeding, or terminates in complete sterility. Another complication, met with occasionally in cows, is a septic inflammation of the udder; but inflammation of the feet (laminitis) is much more common in the mare. For measures of prevention, the reader is referred to "Causes of Metritis and Prevention of Retained Afterbirth." We have little to add to the remarks under these heads, except to advocate strict isolation and disinfection, as in other contagious diseases. Nor should the attendant be permitted to handle other parturient animals. Good management, cleanliness, care in assisting the birth of the young animal, and the exercise of common sense often succeed in preventing the disease. If metritis develops under these conditions, it is milder in character, as a rule, and more amenable to treatment.

Treatment, to be of any avail, must be adopted in the very first stages directly the appetite and milk begin to fail. Until the veterinary surgeon arrives the patient should be made as comfortable as possible, warmly but lightly clothed, the hind parts washed and disinfected, and the vagina douched in the manner recommended for retained afterbirth. A little fever medicine, like sweet spirits of nitre, and a little whisky may be administered; but purgatives of any kind should be avoided meantime. The general or internal treatment will, of course, vary with the case; yet it must always be energetic in order to support the rapidly failing strength. *Stimulants* of various kinds, including alcohol, prove of great service as a rule, provided they are given in quite small doses every two or three hours, both day and night. Gin in 4-ounce doses has given the best results in our cattle practice. Quantities of strong coffee are also beneficial (especially in bitches), or subcutaneous injections of caffeine, with or without small doses of strychnine. In bad cases an injection morning and evening can be recommended. Quinine and other drugs, called *internal antiseptics* or blood medicines, are also in general use. They certainly lower temperature, although they may possess little or no power to neutralize the poisons circulating in the blood, or prevent their continued absorption from the womb. But the benefit derived from medication is small unless plenty of nourishment is afforded at frequent intervals. *Nutrients*, therefore, are essential. They include: milk, gruels, linseed and hay tea, barley-water, beef-tea, and eggs. Every endeavour should also be made to tempt the appetite with green stuff, boiled food, roots, etc., according to the species of animal and the time of year. The administration of a serum, vaccine, or other special agent must be left to the discretion of the surgeon in charge.

Local treatment has for its object the cleansing and disinfection of the uterus without exciting excessive straining and pain, either from the introduction of the hand or the use of irritating chemicals. A good plan is to fill the uterine cavity with boiled water or salt solution (one drachm to the pint of water) until the returning fluid is quite clear. It is got rid of partly by the animal herself, partly by the pressure of the hand in the bowel (in large subjects), while the remainder is siphoned off. Having thus carried out the cleansing process, and removed all traces of afterbirth, fœtus, debris, and septic fluid, the uterus is filled with one of the following solutions: peroxide of hydrogen (1 in 100); chinosol (1 in 600 to 1000); permanganate of potash (1 in 500 to 1000); cresol or carbolic acid ($\frac{1}{2}$ per cent—roughly, 5 tablespoonfuls to a 3-gallon pail of water). The first-named may be injected, removed, and followed by any of the others, after which the womb is emptied as thoroughly as possible. A sedative antiseptic pessary containing iodoform or salol may then be introduced to dissolve slowly, and diminish the toxic effects of the septic material, which again collects in the most dependent part of the uterus. The aim of the practitioner is, obviously, to bring every part of the uterine wall in contact with the injected fluid, the temperature of which should be a little above blood-heat. A rough and ready test consists in pouring the fluid, before injection, over the operator's elbow and arm. But the owner should realize the rationale of the procedure, and the fact that these measures can have but little effect in allaying inflammation and checking absorption unless they are repeated once or twice daily for several days. A long rubber tube with lateral openings will be found very suitable for the purpose. If the dilated uterus can be induced to contract by this treatment (judged by the hand in the rectum), more hope of recovery may be entertained. Needless to say, the method which we have outlined can only be carried out safely and efficiently by a veterinary surgeon. Again, it must be remembered that the inflammation generally involves the vagina and other portions of the maternal passage. Hence great care is required to avoid violent straining during the insertion of the hand, thus weakening the patient still further. In some cases it may be advisable to discontinue the injections, both vaginal and uterine, and to rely upon pessaries inserted into the vagina with the fingers. The same principles of treatment apply to small animals, in which the hand cannot be introduced into the passage. The procedure has already been discussed under "Retention of the Afterbirth in the Bitch." To the remarks under this heading we would add that in most cases in which there is retention of a decomposing puppy, or portion of afterbirth, the early removal of the whole uterus through an incision in the abdominal wall offers the only prospect of recovery. But the operation must be performed early before the symptoms of blood-poisoning become pronounced.

Post-partum Hæmorrhage, Bleeding from the Uterus and Vagina, Rupture of the Uterus.—These uncommon accidents incidental to, or following, parturition are most frequent in the mare and cow. As a rule, they take the form of lacerations and ruptures of the vagina, cervix (neck of womb), and uterus. It may happen that injuries are produced in rapid or precipitate labour, a condition almost confined to heifers, in which parturition sets in too hurriedly before the "os" has had time to dilate; but, in spite of the violent and almost continuous straining, during which the rectum may be forced out several inches, lacerations and hæmorrhage are of rare occurrence. Not infrequently the inverted uterus and vagina are torn (see "Inversion"). But the great majority of cases occur as the result of difficult protracted labour. Any animal may be slightly, severely, or fatally injured during difficult parturition, either by the hands and instruments of the operator, or by the feet, points of the hocks, and other parts of the fœtus. The danger from the hocks is greatest in hock and breech presentations (Figs. 336 and 337). The accident is favoured by forcible attempts to deliver the young animal in the absence, or during the interval, of labour pains, or when the womb is dry and tightly closed round the fœtus. Yet *the chief cause of rupture is forced extraction while the fœtus is in an improper position.* Most commonly it is the feet which tear, or actually penetrate, the passage or uterus. The mare with her strong and violent pains sometimes forces the foal's foot right through the womb, or through the roof of the vagina and floor of the rectum (the foot appearing at the anus). The foal's long limbs, it will be remembered, are also more difficult to straighten, and powerful straining at a critical moment may easily wound the dam. For these reasons rupture of the uterus occurs most frequently and most quickly in the mare. The cow, on the contrary, is seldom seriously injured until she has been in labour for several hours. The wound, in any animal, varies from a slight scratch in the mucous membrane, a non-penetrating lacerated wound in the muscular wall, to a small or large rent perforating all the coats, constituting a complete rupture. More or less bleeding takes place irrespective of the cause, although no blood may appear at the vulva. It should be borne in mind that the hæmorrhage which sometimes takes place in separating the fœtal membranes is never profuse or dangerous, although it is a strong indication for delay (see "Retention of the Afterbirth").

Symptoms.—If complete rupture of the uterus happens during birth, three important symptoms claim attention: (1) The labour pains in every case suddenly cease—this is always a bad sign;

(2) serious symptoms of internal hæmorrhage often supervene; (3) protrusion of the intestines through the rent (which may be in the vagina) occasionally takes place. Death may be expected quickly from profuse bleeding; but the animal may live a day or two until peritonitis sets in from leakage into the abdomen. Wounds on the floor of the uterus are most dangerous on this account, for septic fluids naturally gravitate to the lowest point. Yet death does not always follow rupture. Small wounds, especially those which do not penetrate, may be readily overlooked, or even impossible to detect on manual examination; whereas large ruptures are easily located when the hand is introduced shortly after the accident. While lacerations of the neck of the womb, and wounds of the vagina and vulva, are easily felt, and sometimes seen, in the case of moderate injuries situated far forward there may be no immediate symptoms to warn the attendant. Occasionally there is straining, the passage of a little blood, followed by pain, a discharge, and a rise in temperature. It cannot be too strongly emphasized that parturition wounds are always septic, the infection being due to the presence of large numbers of septic organisms. Hence inflammation, abscess formation, or blood-poisoning may result.

Treatment.—Remedial measures will probably prove futile in extensive injuries. The first object is to empty the uterus, the second to induce the organ to contract. At the same time the patient must be supported by warmth, stimulants of various kinds, saline injections under the skin or into a large vein, and by the administration of styptics or drugs which check hæmorrhage. The fœtus, if present, is carefully delivered; blood-clots, afterbirth, debris cleared out of the womb; and the cavity swabbed as completely as possible with an antiseptic or styptic, such as adrenalin or dilute perchloride of iron. The uterine contractions, on which so much depends, are also stimulated by stroking the surface of the uterus with the hand through the cervix, and by a vigorous massage of the organ through the rectum. Under no circumstances should the womb be douched with fluid, which may easily find its way into the abdominal cavity through the rent. An exception to this rule might be made when it is clear that the wound is superficial and situated not far from the vulva. Such wounds are dressed without much difficulty, and some may even be stitched. To stop the bleeding, the attendant should pour cold water over the loins, keep the animal quiet, and, if necessary, push a clean sheet soaked in cold water far into the passage. In addition to these first-aid measures, the surgeon will probably administer adrenalin, ergot, or pituitrin; injections of caffeine and salt solution also prove very beneficial, both to keep the heart going and to take the place of the blood which has been lost. A useful old-fashioned drench, which the owner may administer forthwith to a cow, contains two ounces each of turpentine and perchloride of iron tincture; mix well with white of egg and a little milk, and add milk to make one quart. This large dose should not, however, be repeated without professional advice. Lastly, in the case of the vagina, injections of very hot water may be tried to arrest the hæmorrhage when it becomes certain that the wounds do not penetrate.

A. W.

STERILITY

By sterility is meant the failure on the part of an animal, male or female, to procreate its species; the terms unfruitful, infertile, and barren are also applied to such unprofitable members of the herd, stud, or flock. Sterility is a disease, or rather a symptom of disease, of the reproductive organs which causes great, continuous, and increasing loss to agriculture. Whilst only the fringe of this complex and highly specialized subject can be touched upon in the space at our disposal, it is hoped to deal somewhat fully with the important question of prevention. At the outset it must be frankly admitted that certain problems still remain unsolved; and the breeding powers of many valuable animals are suffered to fall into disuse largely because sterility has not received the detailed consideration which it deserves. Although breeding lies at the very foundation of agriculture, it is common knowledge that infertility, like contagious abortion, is increasing, especially under intensive systems of management. This deplorable and constant waste of good breeding material cannot be allowed to continue under conditions which make special efforts to improve British stock-breeding more than ever necessary. Among the many problems requiring present attention are emphatically those which relate to the pathology of breeding.

Losses.—In many herds and studs the existence of a certain number of infertile animals has come to be regarded as natural or inevitable. Unless the sterility figure exceeds three to five per cent, few if any precautions are taken, and no treatment is attempted. This general statement, to which there are commendable exceptions, applies particularly to farm and dairy animals which are often useful for other purposes. The loss is less real and less apparent when the cow can be fattened for the butcher. But a valuable 1000 or 1200-gallon cow of a deep milking strain is clearly sacrificed if no serious efforts are made to overcome or prevent the disease of the womb and other organs on which sterility as a rule depends. The loss is both immediate and remote. It is excessive in breeds like the Jersey and Ayrshire, whose beef value is small, whilst it is very serious indeed in high-priced pedigreed animals of any species which are kept solely for breeding and show purposes. The keep of these barreners, their deterioration, the absence of offspring, and interference with the perpetuation of valuable strains, the serious reduction in the milk supply, the sale of too many individuals, together with the wear and tear of the male, are matters which claim earnest attention. Although the annual wastage is difficult to determine, it is generally conceded that the loss both to individual owners and to the State is enormous. It is probably the case that about 25 per cent of mares and 8 per cent of cows in the United Kingdom are sterile. These figures are merely rough averages founded partly on the writer's personal experience, partly on information furnished by individuals and societies. Needless to say, the figures vary greatly in different parts of the country, more particularly in cattle. Thus 20 per cent of the cows and heifers in abortion-infected districts are not uncommonly attacked. No statistics are available in regard to cows and bitches. Figures relating to horses are practically confined to thoroughbreds; for, until recently, only thoroughbred breeders were required to make an annual return showing what their brood mares were doing, whether they produced a foal or were barren. Owing to the lack of proper records, most of the Breeding Societies are unaware of the extent to which infertility prevails among the animals in which they are specially interested. There is, however, a brighter side to the picture.

Notwithstanding the existence of contagious abortion, sterility may be largely prevented by proper hygienic measures before, during, and after parturition in all animals. There is no doubt that the problem of control is susceptible of solution in a much larger measure than is ordinarily supposed. The intelligent anticipation of the effect of little causes before they become big ones will go a long way to solve the problem of this slowly-developing and insidious disease. Whilst we cannot make every animal productive, experience has shown that the number of temporary and permanent cases of sterility can be reduced very materially. But the help which science can give to Nature must be fully recognized, as shown by the intelligent co-operation of the up-to-date breeder and his expert veterinarian. With closer collaboration between the sciences of veterinary surgery and agriculture, and a thorough application of rational preventive measures, marked developments may be expected in the near future. We would not underestimate the difficulties, but these must be overcome by increased knowledge and sheer hard work. There is no doubt that a great demand will be maintained all over the civilized world for highly-bred British stock, particularly horses, cattle, and sheep. That this demand will be met is evidenced by the brisk competition at recent sales, and the determination of the patriotic breeder to prepare for future requirements regardless of present cost. Amongst other encouraging signs of the times are: the selection and branding for stud purposes of imported mares by the army authorities; the system of grants and premiums for small as well as large farm animals; and the annual registration and examination of stallions initiated by the Board of Agriculture.

Need for Investigation.—It is a regrettable fact that British breeders, veterinarians, and scientists have hitherto paid scant attention to sterility, although the subject is of paramount importance and interest both from the economic and scientific standpoints. What is required is a more thorough knowledge of the principles of breeding, the use and abuse of the male, the general management and feeding of both sexes, the structure and functions of the reproductive organs, and, above all, a clear conception of the immense influence of parturition and abortion in the production of infertility. The time is rapidly approaching, we venture to predict, when the progressive agriculturist will no longer permit the accumulation of "drones" in the form of irregular breeders and barreners, and when every effort will be made to stop the constant supply of recruits. The scientific knowledge which is lacking can only be gained by research work along experimental lines. In this connection it may be opportune to mention the decision of the Development Commission some years ago to make a substantial annual grant for research in animal breeding in Scotland. The scheme includes experimental work on farms and in laboratories, particularly in the larger animals, in which sterility is not only most prevalent but most wasteful.

Breeding Records.—Within the last decade the excellent practice of keeping records, particularly milk records, has come into vogue in many well-managed dairy herds. The procedure is adopted at the present time mainly by those dairy-farmers who are in a position to breed their own stock. Apart from these fortunate individuals, the question may be asked: "How many breeders keep a systematic record of the breeding performances of their animals?" Again: "Is the service card in universal use in the case of pure-bred stock, and, if so, is it duly completed in every detail, and indexed or posted up for future reference?" It must be admitted that the Stud and Herd Books of the United Kingdom, other than the *General Stud Book*, give few or no details of the number of females served and the number of living offspring produced, whilst returns of barren mares and cows are conspicuous by their absence. It is surely of great import to be told the number of services performed by a certain sire and the number of resulting full-term pregnancies. Nor are the members of the various breeding societies enlightened in regard to other important matters in which they are, presumably, interested both from a pecuniary and a scientific standpoint.

No doubt these books are framed for a different purpose, but we are glad to note that more information is becoming available with regard to sires. Reverting to the dam: the history of each animal; its behaviour at parturition, with the fate of the afterbirth; the periods and character of œstrum, etc., these and other data would not only assist the breeder in the conduct of his business but they would prove of inestimable value in the elucidation of the sterility problem.

Empirical Methods.—The inability of the breeder to perpetuate certain strains owing to the persistent barrenness of some of his best animals, together with the regrettable confusion which exists in the minds of some as to the real cause, is responsible for the employment of the quack, whose colossal ignorance is only equalled by his supreme self-confidence. Generally speaking, a curtain is drawn across his many failures. In cases in which apparent success has attended his blindly-directed efforts, a change of sire, some alteration in the details of management, or time alone may have effected a cure in females which were only temporarily sterile, whilst both "operator" and owner remain in ignorance as to the cause. Furthermore, the amateur is sometimes the cause of serious injury and infection, complications which may render a simple case incurable. Yet, in spite of the "certain cures," both medicinal and operative, sterility is steadily increasing in this and other countries.

Structure and Function.—The following brief description will, it is hoped, enable the reader who is unfamiliar with the form, position, and uses of the female genital organs to follow our subsequent remarks with more interest and comprehension. There is less need to refer to the simpler genital apparatus of the male. The principal female organs are the ovaries, uterus or womb, vagina, and vulva. The first two are situated in the abdomen and may be readily examined in the mare and cow with the hand in the back bowel, called the rectum, and in the passage called the vagina. The ovaries in the mare are about the size of a duck's egg, somewhat kidney-shaped, smooth, firm, and notched; they lie under the loins a little behind the kidneys, above the intestines. Each ovary is attached to, and in communication with, the uterus on its own side; but they are rather widely separated. In the cow they are much smaller, rather less than a walnut, and situated close to the entrance of the pelvis. The uterus in all animals is made up of a small main portion or body, terminating behind in a neck, and dividing in front into two branches called horns; these horns are long and curved, tapering at their anterior extremities where they communicate with the ovaries. The mare's uterus is shaped like the letter Y, being firmly suspended and spread well forward in the abdomen; the cow's womb, on the other hand, curves backwards, bringing the extremities of the horns and the ovaries within easy reach from the vulva. In both animals the neck or cervix is a short thick tube which projects backwards into the vagina in the form of a tap-like projection called the os uteri, or more often the "os." The cervix may be regarded as the mouth of the womb, for it opens at its anterior end into the body of the uterus. The passage which connects the uterus and cervix with the external parts is termed the vagina, which is about ten inches long, and is lodged entirely in the pelvic cavity. The rectum lies above the vagina and the bladder below it. The vagina is succeeded by the vulva, which opens under the tail just below the anus. Proceeding in the opposite direction, the genital canal, as it is called, is formed by the vulva, the vagina, the neck, body, and horns of the uterus, which reach to the ovaries. At one end we have the vulva, at the other the ovaries. The whole canal is lined by a red, velvety, moist and delicate covering called the mucous membrane, which is easily injured by rough handling, strong disinfectants, or as the result of copulation and parturition. The muscular tissue which forms part of the canal wall is present in greatest amount in the uterus, especially during pregnancy. Here it constitutes the principal expelling force which gives birth to the fœtus. The function or use of the ovary is to mature and discharge the ovum or egg which scientists call the germ cell. The discharge of the ovum is essential to reproduction, and it only takes place during the period of œstrum, or rutting. If connection with the male takes place about the same time, the male cell or sperm present in the semen deposited in the genital canal, penetrates and fertilizes the female cell. The fertilized ovum then reaches and becomes attached to the now pregnant uterus, from which it derives its nourishment. The result is the development of the young animal which we call the fœtus. Coincidently with these changes, important alterations take place in the dam, mainly in the uterus. In nearly every case the cervix remains sealed throughout pregnancy. The words gestation and pregnancy need no explanation; they indicate the period which begins with conception and ends with birth. Œstrum or heat is the expression of sexual desire in the female. In the domestic animals it occurs at more or less fixed periods, and is characterized by certain symptoms which are peculiar to each species. It is a well-known fact that impregnation can only occur during œstrum; hence all breeders look for the signs, and endeavour to cover the animal at the right time; if not properly in season, the connection may not take place, or the female may be injured during the service. Two essential phenomena occur at this time in all animals: in the first place, the ripe follicle containing the ovum forms like a blister on the surface of the ovary; it bursts and the ovum is set free ready to meet the male sperm, as already mentioned; the second is the softening and opening up of the cervix to admit the male fertilizing fluid (semen) into the uterus. From this it is evident that conception requires an open, healthy genital canal, containing the necessary active germ cells, male and female. This leads us in natural sequence to a consideration of the causes of failure on the part of an animal to conceive, which depend upon some departure from these normal (healthy) conditions.

Causes.—It is now recognized that many of the factors which limit or prevent fertility are merely predisposing or contributory causes, whilst the actual cause is often a definite diseased condition of some part or parts of the genital organs. It is rare to find the male totally and permanently sterile, although he may prove an indifferent stock-getter or actually sterile at times. That the female is much oftener affected than the male is not surprising when we consider the number and nature of the risks to which she is exposed, especially as the result of parturition. The female organs are also more complex than the male, and they are therefore more liable to disease, the uterus in particular. Sometimes loss of function rather than structural change appears to be the cause of the trouble; for example, the semen is thin and weak, or œstrum is absent, irregular, or excessive. The uterus may be quite healthy, but the ovary fails to form or discharge the ovum. On the other hand, fertilization of a healthy ovum is of no avail if the ovum cannot obtain a firm attachment to the uterus on account of disease. A cure cannot be claimed if successful efforts to impregnate an animal are followed by early abortion. But it is common knowledge that abortion frequently leads to sterility; indeed the two conditions are so intimately associated that they have been described as different phases of the same disease.

What may be termed mismanagement is responsible for a certain number of infertile animals; this includes errors in diet, work, or exercise; over-use; withholding the bull; and, possibly, in-breeding. Many **foods** are blamed for causing sterility, but the evidence is by no means convincing. Generally speaking, nitrogenous foods like peas and beans increase vigour and therefore sexual desire; whilst grains, maize, and similar materials are less active in this respect. The fact is that the constituents of a rational diet are of minor importance, provided the diet is suited to the circumstances of the particular case. At the same time stimulating artificial foods are best avoided for breeding animals. It should be remembered that the presence of pronounced œstrum is no guide as to the female's ability to breed, nor is the power to copulate any criterion of sexual soundness in the male. After all, it is the amount of food, rather than the actual constituents of the diet, which is the important point. This depends upon the age, the amount of work, and the number of services on the part of the male. Thus, a stallion serving, say, eighty mares, or a bull a hundred cows, requires a generous diet rich in proteids; but the ration needs to be considerably reduced during the off season. Most harm is undoubtedly done by over-feeding. This is a common practice in animals intended for shows and for the sale yard. The intensive system of management, to which pure-bred stock in particular are subjected, is probably responsible for most of the sterile young bulls and heifers. At the same time the extent to which high-feeding *per se* is responsible is not always clear, for it is frequently accompanied by insufficient exercise. If, in addition, the cow has a long milk ancestry, several factors combine to weaken the genital organs and to make them sluggish. In some instances, however, the laying-on of fat appears to be the result, not the cause, of the sterility; the infertile animal may exhibit a tendency to fatten. With regard to **exercise,** there is a general consensus of opinion that confinement, like over-feeding, lessens fertility, and that bulls, no less than mares and stallions, should receive regular work in order to preserve their breeding powers. Bulls in confinement become increasingly lazy and heavy after four years old, and their fertility rapidly diminishes. Plenty of freedom is always advisable for the smaller animals. The opposite conditions, poverty and overwork, are relatively unimportant, except perhaps in young males. A mare in poor condition usually conceives, but systematic overwork may cause her to slip her foal. If the foal is carried to full term it suffers from insufficient milk. Our next point, **excessive sexual use,** has reference only to the sire. Not infrequently, when parturition is required to take place at a certain season, the powers of a male are overtaxed by too frequent use during a comparatively limited period. Abuse of this kind is commonest among young bulls when first put to stud, especially when they are allowed to get down in condition. The result is not difficult to foresee ; the semen becomes watery and less potent, the male sperms sluggish and few in number, and the act of copulation is indifferently performed and increasingly unsuccessful. If neglected, the young bull becomes unable to copulate. Incidentally his heifers and cows come in season again at regular intervals, and the whole time-table and internal economy of the herd are disarranged. Again, some stallions are allowed too many mares at the beginning of the season before they are properly conditioned for stud purposes by a rational system of management. The preparation of the stallion by means of regular work and moderate judicious feeding will materially increase the number of foals, provided he is allowed only a few mares during the first few weeks. Later on, during the heavy part of the season, all authorities are agreed as to the necessity of generous feeding and the maintenance of good condition for the proper performance of the work. Practically all breeders limit their stallions to a certain number of mares according to age and other considerations ; but it is highly important that the animal should be in good hard condition at the beginning of the season, not too fat and soft. **Age** is seldom an obstacle to conception. Whilst it is true that the semen of very young males is of low fertilizing power, yet a young sire of breeding age is always more prolific than an old animal, provided he has been properly fed (not overfed) and cared for. Again, many brood mares continue to produce foals with more or less regularity to a good old age. Yet every one knows the difficulty which is experienced in impregnating a mare covered for the first time late in life. Those which have been in work for a number of years require a long run at grass. It must be admitted, however, that as age advances there is a tendency to senile decay of the essential organs of reproduction, the ovaries and testicles, which of course reduces or abolishes fertility. We believe that heavy fat males, and females which have not been regularly bred, suffer most in this respect. Without discussing the merits and demerits of early breeding, it is a matter of common experience that mating at a reasonably early age tends to insure regularity in breeding and a proper activity of the mammary glands. With regard to lactation, experts are agreed that when a mare served late in life becomes pregnant, she is frequently short of milk when she foals. At this stage we would direct attention to the practice of *withholding the bull* which prevails, in normal times, in some large dairy herds. The object is, naturally, to prevent cows calving down during the off season when there is less demand for milk. The London market may be cited as an example. By systematically preventing animals from breeding, sterility, at least of a temporary nature, may easily be induced. We have repeatedly observed difficulty in getting cows in calf which have been subjected to this unnatural interference. Another contributory cause of comparatively slight importance is **in-breeding.** This acts by reducing vigour and therefore the fertility of the domestic animals. Highly-bred and in-bred males are considered by some to be less potent, but a great deal depends upon their rational handling. Lastly, **climatic and nervous influences** call for some mention. They include extremes of heat and cold, changes in the environment, and excitability. Spring is, of course, the natural or ideal time for conception to take place. Thus cows which cannot be got in calf whilst tied up during the winter frequently become pregnant when turned out with the bull in the early summer. Mares are most prone to suffer from undue excitement ; they appear to be very sensitive in the vagina, which may be in a state of spasm. The mare strains violently after the service and ejects the semen. This pronounced irritability is not due, as a rule, to any injury or disease of the passage or hind parts. Rather is it a matter of temperament. A good gallop or a long spell at the plough will frequently settle a nervous mare and enable her to conceive. In this connection it is interesting to note that the Arabs often gallop such mares to a standstill, and then put the horse over them. Ejection of the semen may be prevented by pouring or dashing cold water over the loins, walking the mare about in order to distract her attention, or by the application of the twitch. In some cases it may be necessary to administer a dose of sedative medicine shortly before copulation.

The actual cause of sterility usually has its seat in the genital organs themselves, which are affected with some disease. **Abnormalities** are rare. The young animal is born fully developed and potentially productive in nearly every instance. Needless to say, when certain parts are defective or absent at birth, sterility is the invariable result. These anomalous conditions occur in rig colts with abdominal testicles, in hermaphrodites with genital organs of both sexes, in hybrids like mules, and in the case of some twins. It is generally recognized that the female of twin calves, the so-called free-martin, is nearly always infertile. Another peculiar abnormality, familiar to shorthorn breeders, which interferes with or prevents copulation, is observed in "White Heifer Disease" due to the persistence of the hymen or adhesion of the walls of the vagina. Unlike most congenital defects, it is amenable to treatment by opening up the closed passage and preventing reunion during the healing process. Of more importance are those diseases which can be brought more or less under control, and which are very prevalent in barren animals. We refer particularly to **chronic inflammations of the uterus and cervix,** and **cysts in the ovaries.** These inflammations frequently follow abortion, and, to a less extent, ordinary parturition, owing to the fact that infection of the uterus readily takes place at such times. In many herds the number of cases of abortion bears a close relation to the number of sterile cows and heifers. By infection we mean the invasion of micro-organisms, which occurs, apart altogether from abortion, when the genital passages are injured during the birth of the fœtus. Retention of the afterbirth is also a prolific cause of infection, and therefore of sterility. In mares abortion is a less common cause of sterility, although many mares, like cows, abort either at grass or at work before the twelfth week. This early "invisible" abortion is seldom observed. The mare is tried regularly with the horse until she suddenly comes in season. Unless this occurs too late in the year, she usually becomes pregnant a second time, and carries her foal to full term. Cows, on the other hand, usually go over to the bull several times after abortion at all stages of pregnancy. It is a well-known fact that mares seldom slip their foals a second time in succession. But sometimes the fertilized ovum or embryo is not expelled at once. It dies in the uterus and is retained there for a time, being eventually got rid of as a more or less destroyed mass. When this happens, the uterus may be converted into an abscess. The cause of such early abortions must be sought for in disease of the mucous lining of the uterus, which prevents the proper nourishment of the ovum, and its intimate attachment, which ought to take place during the second month of pregnancy. Before proceeding further, attention should be directed to the close relation which exists between the genital organs, whereby inflammatory processes beginning in the cervix or uterus frequently spread to the ovaries or vagina, or both. The ovaries may be first affected, in which case the disease generally extends to the uterus. Hence, in examining mares and cows which have been barren for some time, the veterinary surgeon may find signs of disease in several organs, each of which requires different handling. The owner will realize that these complications inevitably delay, and sometimes prevent, recovery. Taken in the early stage, however, the affection is, generally speaking, simple and uncomplicated, and admits of a fairly rapid cure. The fact that the cervix is more frequently affected in mares accounts for the success which attends the indiscriminate practice of "opening the womb" and the operation known as artificial insemination. Disease of the neck or cervix may arise from injuries in copulation, or rough handling by amateurs; but many cases are due to laceration and bruising during difficult or precipitate labour. It is therefore not surprising that maidens are seldom affected.

Physical inability to copulate may be observed in either sex, more especially in the male, from adhesions, tumours, inability to erect or introduce the penis, or disparity in size. In the latter instance the female is too small or too large for the male. Sometimes the male animal is able to mount and introduce the penis, but he is powerless to complete the act. This occurs in stallions which suffer from excessive erection, and it is curious to watch their behaviour with mares in use; the large penis may or may not be able to enter the vagina; if so, no semen is discharged, and hence there is an absence of the characteristic wave-like movement on the under surface of the penis and the organ is withdrawn still erect. These symptoms should be carefully observed, for they always mean that the male is useless.

Sterility is thus due to many causes, some of which cannot be enumerated here. Briefly, it arises from functional derangement or organic defects, the result of mismanagement or disease. We might add that the cause may be readily apparent, or it may require several examinations by an expert. In exceptional cases it may elude the most careful search.

Symptoms.—The fact that the animal fails to breed may be sufficient, or more than sufficient, for some owners. But close observation of its behaviour is necessary for the accurate diagnosis and cure of the disease. The most prominent symptom in the female in all domestic animals is the occurrence of abnormal œstrum—that is to say, the heat is too frequent, excessive, too short or weak, or altogether absent. It is evident that we have three different things to consider, viz. the periods, the degree or intensity, and the duration of the œstrum, any or all of which may be at fault. In the first place, the animal comes in season too frequently or at too long intervals. Here the *period* is at fault. Whilst the normal period naturally varies in each species, in the healthy cow and heifer, for example, œstrum occurs every three weeks, or twenty to twenty-two days. Most cows take the bull six to eight weeks after calving; some may even come in heat in four to six weeks; on the other hand, the signs of œstrum are generally delayed for several months in deep milkers, and to a less extent in those cows which are suckling their calves. In the second place, the *degree* of heat varies greatly; in some it is very excessive, constituting what is called nymphomania. This condition, which may be slight or very marked, is characterized by frequent or constant general and sexual excitement; there is loss of condition and diminished milk secretion; affected animals cease to thrive, become irritable and restless, whilst they tend to mount and annoy others, and even become positively vicious. Mares frequently kick; they are very ticklish and squeal, as a rule, when touched, and they often pass urine in small quantities. As regards age, nymphomania is mostly observed in mares past middle age, in cows between the fourth and the seventh calf, and in bitches which have been bred several times. The symptom is uncommon in sheep, goats, and pigs, whilst heifers are rarely affected. The nymphomaniac cow is generally called a buller. This is a useful term, for it gives a good idea as to the animal's condition. In most cases cysts are present in the ovaries; they are the chief cause of the exaggerated œstrum, although the latter symptom may be absent. The cysts interfere with the formation of healthy ova with resulting sterility. But nymphomania is also produced by chronic inflammations of the uterus and cervix; indeed, one frequently finds the whole genital canal from the ovaries to the vulva more or less affected. Thirdly, the *duration* of the œstrum is brief or prolonged. If too short and weak, it may be unobserved, especially during the night; sometimes it is prolonged for several days. The average duration in a healthy cow is about sixteen to twenty-four hours. In animals which are closely confined for long periods œstrum is often weak, although the periods and duration are quite normal. No disease may exist in such cases, which are quite common in dairy cows. The cows may not even go out to water for six months, and œstrum may be so slight in some of them that it passes off unnoticed, except by a very careful cowman. The presence of a blood-stained discharge from the vulva shows that heat has just taken place; but it is too late to offer the bull. A little blood is commonly seen in cows on the second day after the onset of œstrum, provided conception has not occurred. It is therefore a bad sign for the breeder after service with the bull.

Lastly, œstrum may be quite absent, and the cow or heifer is known as a dumb buller. Naturally, if connection has taken place before œstrum ceased to make its appearance, the animal may be thought to be pregnant. Here, again, the ovaries and uterus may be diseased, as in the opposite condition, nymphomania; but on inserting the hand into the rectum and feeling the ovaries we have frequently found a fleshy growth, the removal of which has been followed by œstrum and conception. Before leaving the important subject of œstrum, we would point out that the above symptoms are usually, but not always, associated with sterility. But it seems a confusion of cause and effect to attribute the sterility to the abnormal œstrum. Animals so affected are sterile, not because they exhibit abnormal œstrum but because of physical changes in the genital organs arising from disease of these parts. The altered character of the heat is a symptom of this disease. Again, some infertile subjects come regularly in season and take the male; but such cases are exceptional, and careful observation will often detect some alteration, however slight, in the duration or intensity of the œstrum, with, possibly, some of the following local symptoms. From what has been said, it is plain that the characters of the œstrum constitute a valuable indication of the animal's soundness from a breeding point of view. These characters should, we venture to say, be entered in the herd or stud book for future guidance.

Local Symptoms.—In the cow a valuable and fairly constant symptom is relaxation and sinking of the ligaments on one or both sides of the pelvis. This causes the muscles to fall in, and the hip or quarter becomes distinctly flattened. The most marked alteration occurs on each side of the root of the tail; in this situation the firm, tense, cord-like ligament disappears and there is formed a pronounced hollow in which the wrist or arm may be placed. The softening and sinking of this ligament certainly occurs to a slight extent during healthy œstrum, and to a much greater degree in cows preparing to calve. Indeed, all breeders recognize this sign of approaching parturition to which the expression "the bones are down" is often applied. But in healthy cows about to calve the sinking is temporary and equal on both sides, whereas in disease it is permanent, excessive, unequal, or confined to one side. As a rule the hollows point to some disease of the genital organs, especially of the ovaries. Again, a slight slimy discharge may issue from the vulva, adhering to the long hairs and soiling the tail and hind parts. When the uterus is affected, this discharge is more abundant and mixed with dirty, creamy or thin watery pus; the vagina, too, is generally relaxed and widely dilated, and the cervix is wide open instead of being closed, or nearly so, between the periods of œstrum. These four symptoms, viz. the hollows at side of tail, the open vagina and cervix, and the slimy discharge, are often present in nymphomania, as well as in dumb œstrum. Contraction or closure of the cervix is also met with in all animals. That portion of the cervix which projects backwards into the vagina, called the "os," is very often the seat of disease in mares; it becomes thickened, hard, often ulcerated, bleeds readily, and the opening is displaced downwards and to one side. In addition, the cervical canal—in other words, the passage through the neck of the womb—is twisted, requiring care and patience in introducing the finger. The closure of the cervix prevents the semen of the stallion entering the uterus. Lastly, the inflammatory changes already referred to, which are commonly found in the uterus and ovaries of sterile animals, require the expert, with his hand in the rectum, for their detection. These affections of the uterus are often mild in the early stages; they commence some days after parturition or abortion, and, seeing that they may produce comparatively little disturbance of the general health for some time, their existence may not be suspected by the attendant. Nevertheless there is more or less straining for a few days, and a purulent discharge which may gradually subside, only to reappear at the first œstrum. The appetite may suffer, whilst the milk yield is always below par. It is well recognized that a cow does not come to her full milk so long as a discharge is present. If the owner wisely calls in his veterinary surgeon at this early stage the latter soon discovers that the uterus is thickened, swollen, and longer than normal; and already, in some cases, the ovaries have become cystic, large blebs or blisters being distinctly felt on the surface or in their substance. Œstrum soon becomes irregular, or fails to make its appearance; the cervix is closed, and the discharge collects in the uterus to an inordinate extent. If connection has previously taken place, pregnancy may be presumed, but this assumption is easily dispelled by means of an internal examination. It is certainly possible for pregnancy to occur in slight cases of uterine trouble (uterine catarrh); but, for reasons already stated, abortion is liable to follow in a few weeks. Many cows suffering from the disease under consideration (chronic metritis) steadily lose condition, become unthrifty, and give little milk unless rational and timely measures are adopted.

Diagnosis.—In dealing with the problem of sterility in all the domestic animals, the most important thing of all is early and accurate diagnosis. It is clear that we must treat the right spot, know what is worth treating, and get the case early in order to effect a speedy cure before complications have set in. Although prevention should be the chief aim of all concerned, few endeavours have been made to check the disease at its source. One reason for this unfortunate policy of *laisser-faire* is the ignorance which still exists in the public mind as to the actual starting-point. Let us take a typical case in a cow which has been "over" repeatedly to the bull and shows no signs of holding; she may have aborted or had a difficult calving; in either case she probably retained her cleansing (afterbirth) and suffered from a discharge, with slight straining occasionally, for some weeks. The fact that the uterus was diseased was, however, not recognized owing to the insidious nature of the trouble. The infection, which is invariably present in such cases, was allowed to take its course, until extensive and often incurable changes have taken place, not only in the uterus, but also in the ovaries and other parts. The result is much loss of time and waste of money in maintenance for want of simple hygienic precautions during and after calving. It is true that slight infections sometimes recover spontaneously; but the disease, if unchecked, is generally progressive and leads to permanent loss of breeding power. In other words, most cases are simple in their inception; by and by they become difficult or impossible to treat, or not worth treating.

One of the most important duties of the veterinarian is the detection of pregnancy in its early stages. This is necessary in order to avoid mistakes, and also to allow treatment to be begun without delay. Disease of the uterus may be mistaken for early pregnancy, or *vice versa*. Most breeders can recall with sorrow valuable dams which were sold or killed as barren, and which proved to be pregnant. We have always advised, and carried out, the examination of every animal in the herd. This is all the more necessary when abortion or sterility has prevailed to any extent, in order to concentrate one's efforts on the best animals which have not been too long affected. In the cow and mare pregnancy can be detected with reasonable accuracy as early as the sixth to the tenth week; in heifers carrying their first calf, between the fourth and sixth week. A second or third examination may be required at this early date if the uterus is not quite normal, and when no proper record has been kept. The latter will greatly assist the expert in coming to a decision, not only in regard to pregnancy, but in the whole procedure which he decides to adopt in the owner's best interests. In small animals like the bitch, in which a full internal examination cannot be made, the puppies may be felt through the abdominal wall towards mid-term. The following summary of **points to be noted** in the veterinary examination of breeding animals **for sexual soundness** may be of some interest:

(*a*) Female—

1. General character of œstrum.

2. Tension of pelvic ligaments; good, firm "bones" a healthy sign.

3. Presence or absence of discharge.
4. Appearance of external genitals, vulva and vagina.
5. Internal examination, both rectal and vaginal. To obtain reliable information, make at least two, one between and one during œstrum.
6. Complete breeding record.
7. Reaction of vaginal mucus, tested with litmus-paper.
8. Observe act of copulation and subsequent behaviour.

N.B.—Pay special attention to the state of the "os" (cervix), which should be open and soft during œstrum, firm and closed to a great extent at other times.

(*b*) Male—
1. External examination of drawn-out penis; also scrotum (purse), testicles and other parts.
2. Pass catheter, if required.
3. Internal examination through the rectum.
4. If able to copulate, closely observe the act, and note if semen is ejaculated.
5. Collect semen from vagina immediately after connection, and examine with the microscope.

Prevention and Treatment.— This resolves itself, so far as prevention is concerned, into a thorough understanding and avoidance of the causes which we have mentioned. In the actual handling of barren animals, however, effects rather than causes have to be dealt with. The measures which are adopted for cattle are also applicable, with certain modifications, for mares and the smaller species. Reference has been made to the fact that sterility is largely dependent on the accidents and diseases connected with parturition. We would add that when a cow aborts, has a difficult calving, suffers from a vaginal discharge, or holds her cleansing, the veterinarian should be consulted early in order that he may combat the infection and prevent the diseases which give rise to infertility. The significance of checking the sterility disease at its source has not been sufficiently realized. At a later stage, when the mischief has been done, an external and internal examination will enable the practitioner, assisted by the breeding record, to determine the nature and extent of the disease, and, further, whether a cure is probable within a reasonable time; if incurable, the cow will of course be prepared for the butcher and slaughtered when the milk yield ceases to be profitable. Only those cows and heifers which are worthy of retention in the herd will be placed under treatment. At parturition, the chief thing to remember is to avoid infection, which is very apt to occur from even slight wounds inflicted during birth; from dirty hands and instruments, ropes, syringes, etc.; from dirty surroundings, and from retention of the afterbirth. The latter is very common, even more so after abortion than full-term birth, and although it cannot be prevented, its evil effects may be counteracted to a great extent by thorough and frequent cleansing and disinfection of the uterus. The early and complete removal of the afterbirth is always desirable, but not always attainable, and the owner would do well to leave the matter to the discretion of his professional adviser. The hygienic precautions which should be observed will be familiar to every farmer and breeder who has been troubled with abortion, joint-ill, and similar diseases. The animal's surroundings should be clean before calving, but during and after birth the floor and box should be repeatedly cleansed and disinfected, fresh straw laid down, and the hind parts, including the vulva, washed frequently with a mild disinfectant solution. Vaginal and uterine injections are of the greatest importance in difficult births, twins, or in cows and heifers which hold the cleansing; but we would point out that it is not safe to allow a cowman or attendant, however careful he may be, to interfere with the uterus. Apart from rupture, which may easily occur, unskilled hands often do more harm than good. We recall several valuable cows and heifers which were killed or ruined in this way, and hence we may be permitted to utter a word of warning. The vagina, however, may and should be gently syringed two or three times a day with an ordinary quart brass enema pump, to which a fairly stiff rubber tube is made to plug on, not screw on. As an alternative, the ordinary wooden nozzle may be covered with rubber tubing, which is allowed to project a little in front of the nozzle. Any of the following solutions may be employed at blood heat: (1) 1 per cent of cresol solution (Liquor Cresolis Co. B.P.) or Jeyes' fluid, three tablespoonfuls to a gallon of water; (2) permanganate of potash, or Condy's fluid, 1 : 1000. The fluid is added to the water until it is a nice claret colour; (3) perchloride of mercury, 1: 8000-10,000. For bulls and rams, in which the opening of the sheath is very narrow, a metal tube may be attached to an extra-long ball rubber syringe. In addition, the long hairs in front of the sheath should be cut short. The above solutions may be made a little stronger for washing the external parts; but if the strength recommended is exceeded for syringing the vagina and sheath, irritation and severe straining may be set up, especially in young animals. In the case of very sensitive heifers, and where there is much inflammation in any animal, it may be wise to stop the injections, and to use capsules instead. One more remark about vaginal injections may be opportune. It should not be supposed that douching the vagina will suffice to control or prevent infection of the uterus. Employed alone, their value is very limited. They must be supplemented by irrigation of the uterus itself.

The above treatment should be continued twice daily, later on, once a day, until the discharge has ceased for several days—generally about the third week. If a little fresh discharge makes its appearance at the first œstrum after parturition, several more injections should be given. Under no circumstances should copulation be permitted until œstrum is quite normal, and the genital organs are in a healthy condition. Just before connection takes place it is well to douche the vagina with a warm solution of bicarbonate of soda (baking soda) in the proportion of one or two teaspoonfuls, to an imperial quart of water.

Passing to a consideration of the sterile mare and cow, the causes are as numerous and varied as the short cuts to cure, hence no routine line of treatment can be laid down. Each case must be dealt with on its merits by the veterinary practitioner with the full co-operation of the owner and attendants.

As a rule, what may be termed a "combined treatment" is necessary; briefly, this consists in crushing cysts in the ovaries, massaging and cleansing the uterus, opening up the cervix, and performing artificial insemination. One or several of these and other surgical procedures may be indicated, and the operations may require to be repeated. Drugs can often be dispensed with, although tonics and sedatives may be useful in certain cases. Those drugs which excite sexual desire are frequently administered by amateurs, but, as a rule, they have no effect in assisting the formation of healthy sperm and ova. Sometimes, we admit, when the genital organs have been merely sluggish, œstrum being weak or even absent, successful copulation has followed their use. More often, they only succeed in causing irritation, aggravating the disease, and in setting up a kind of false œstrum without increasing fertility. Drugs of this nature are capable of great abuse; they should only be administered by professional advice to animals in which no disease can be discovered after several careful internal examinations. Rather would we recommend strict attention to exercise, work, and feeding, with frequent consort with the male when disease is absent. Backward maiden mares should be frequently teased by the stallion, the cervix examined, and the uterus massaged by means of the hand in the rectum. These manipulations seldom fail when the disorder is merely functional, unaccompanied by any structural change. We have referred to the beneficial effects of work in such cases. Fat sluggish mares are often put to hard work until œstrum appears, and served immediately they are unyoked. Pedigreed cows, which are too fat and therefore indifferent breeders, tend to become vigorous and fertile at the plough. Such work is, however, usually restricted to bulls. In some obscure cases of sterility, in different species, we have known a change of environment produce good results. It is also a fact that a change of stallion, especially a stallion of another breed, sometimes proves effective.

Nymphomania is variously dealt with according to the case. The "combined treatment" at which we have hinted will probably be successful in the earlier stages, with attention to diet and work. Sedative medicines afford only temporary relief, but they may be very useful in controlling the irritation whilst surgical treatment is in progress. The operation for removal of the ovaries, known as ovariotomy, may be necessary. It may be performed in cows, bitches, and other animals, but mares are more often spayed for this reason, with successful results, if the mare is not too old and too long affected. But we must remember that the ovaries may be diseased without the manifestation of vice and excessive sexual desire. When only one ovary is affected, with or without nymphomania, its removal may enable the mare to breed. This partial operation is always worth a trial in valuable breeding stock, large or small.

Inability to copulate may also require surgical interference: for example, the removal of tumours, and the breaking down of adhesions, in both male and female external organs. Contraction or complete closure of the cervix is popularly supposed to be a common cause of sterility, hence rough attempts are often made to dilate a perfectly healthy organ! Disease of this part can only be properly handled by a surgeon, and the operation may require a good deal of time and patience.

Artificial insemination is a very popular operative procedure for barren mares. It is less necessary, but occasionally beneficial, in other animals such as bitches. Females sired by very small or very large males, of their own or a different species, are also sometimes inseminated. The operation consists in introducing the semen of the male, after connection, into the uterus of the same or another mare by means of a special syringe. It may be practised when any obstruction exists to the natural passage of the semen into the uterus. This obstruction may be present in the cervix, vagina, or vulva, most frequently, as we have seen, in the cervix. Conditions which prevent copulation, or which destroy the male sperm, are also overcome in this way. Another advantage is that artificial insemination conserves the powers of the male.

Given several mares in season at one time, the semen from one service can be utilized to impregnate them all, provided certain precautions are observed. It is obvious that in cases where the trouble is situated further forward, viz., in the ovary or uterus, the operation can serve no useful purpose, and attempts to inseminate such animals only tend to cast discredit both on the operation and the operator. In properly selected cases, experience has shown that 90 per cent of inseminated mares conceive when the method is properly carried out. Lastly, we would deprecate the common practice of "trying" barren mares and other animals at frequent intervals when the sterility is due to some of the organic changes mentioned above. Sexual excitement in such cases merely delays recovery; and connection should not be allowed to take place until the disease from which they are suffering has been cured.

Conclusion.—Although most of the remarks in this paper refer to the mare and cow, we might add that they apply also, with certain modifications, to sheep, pigs, and dogs. The handling of sterile animals, especially the larger species, is trying and exacting work; but the results obtained are well worth the pains taken, provided the owner realizes the difficulties which have to be overcome. The writer hopes that he has been able to explain some of these difficulties, and thereby enable the intelligent breeder to avoid them or to tackle them promptly at an early stage when they are much more easily dealt with. But it should be recognized that operative treatment cannot be expected to produce immediate results, at any rate in old-standing cases. Sterility is essentially a chronic disease, and it is well to remember that there is no specific for its cure. Treatment must depend on the practitioner's detection of the cause; and the breeder can render great assistance by supplying full particulars of his animals, and by encouraging his men to carry out the minor details of the treatment to the letter. What is wanted is constant care, attention to detail, and patience.

A. W.

DENTITION

Age as indicated by the Teeth

All the domesticated animals are provided with two sets of teeth. The first set, called the *temporary* or *milk teeth*, are subsequently replaced, at more or less regular intervals, by the second set or *permanent teeth*. The regularity of the eruption of teeth and the effects of wear on their surfaces afford data from which the ages of the various animals may be estimated. It should be borne in mind, however, that variations are not infrequent. Some animals are precocious in the eruption of their teeth, which give the impression at the time that they are older than they are in reality, while on the other hand the eruption in some cases is retarded, having the opposite effect.

The portion of a tooth above the gum is called the *crown*, while the portion embedded in the gum and bone is called the *root* or *fang*. The junction of the crown and root, frequently indicated by a constriction, is called the *neck*, while the surface, which comes in contact with the opposing tooth, or dental pad, is called the *table*.

Teeth are composed of four tissues; the bulk of a tooth is composed of a hard, yellowish-white substance called *dentine*. The dentine of the root possesses a cavity which is called the *pulp cavity*. This is filled with a soft gelatinous tissue called the *pulp*, which is well supplied with blood-vessels and nerves. The dentine of the crown is covered by a hard, white or bluish-white *enamel* which acts as a protective agent. Round the dentine of the root is the cement substance or "*crusta petrosa*," which has a structure somewhat resembling bone. In so-called complex teeth it is also present in the spaces between the enamel folds of the crown. The socket into which the root of the tooth fits is called the *alveolus*, and the root is secured in this socket by the gum and a vascular layer called the *alveolar periosteum*.

The Horse

The teeth of the horse consist of six incisors or front teeth, two canines or tushes, and twelve molars or grinders in each jaw.

The Incisor Teeth.—The horse possesses three pairs of incisor teeth in the upper and in the lower jaw, named respectively, commencing from the mid-point, centrals, laterals, and corners. In estimating the age the incisor teeth of the lower jaw are usually referred to.

Temporary Incisors.—Temporary teeth may be distinguished from permanent teeth by being much smaller and possessing a distinct neck between the root and crown. The crown is short and wide, and shell-like in appearance, and is either smooth or slightly fluted. The root or fang is small and flattened. The tables of temporary and permanent incisors both possess a depression called the *cup*, *mark*, or *infundibulum*. This is much shallower in the temporary than in the permanent teeth. It is always surrounded by a ring of enamel.

At birth or within 10 days the foal possesses in each jaw the central incisors. These are followed by the laterals at from 4 to 6 weeks old and by the corners from 6 to 9 months old. Thus at *1 year old* all the temporary incisors are present, the centrals show a little wear, the posterior margin of the table being level with the anterior margin, while the corner teeth are still sharp and shell-like.

At *2 years old* all the incisor teeth show wear, the infundibulum has disappeared from the centrals and laterals and sometimes from the corners. The teeth are a little wider apart at their necks on account of the gradual widening of the jaw with age.

Permanent Incisors.—The permanent teeth may be distinguished from the temporary incisors by being larger, broader, and more solid-looking, less shelly, and the neck is not well marked. They possess distinct vertical grooves down the front and are usually discoloured or dirty-looking.

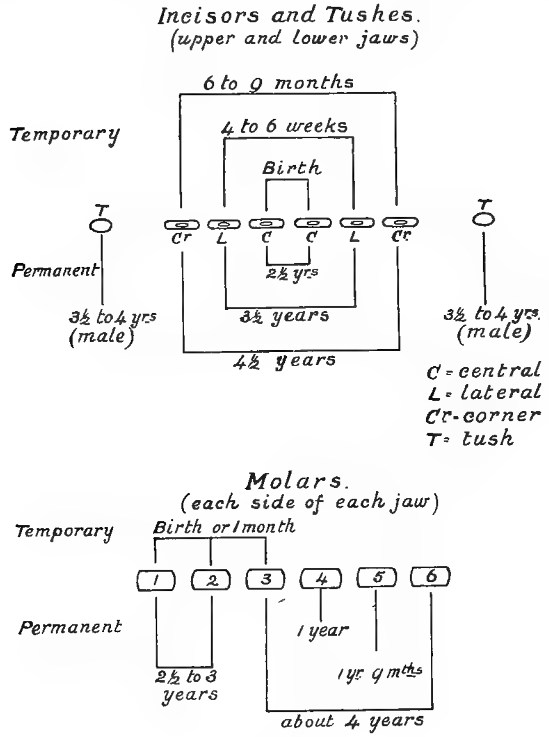

Fig. 340.

At 2½ years old or thereabouts the central temporary incisors are shed. The permanent ones then make their appearance, and are level with the other teeth at 3 years old. Thus, at *3 years old* a horse possesses two large central permanent teeth and four milk teeth in each jaw.

At about 3½ years the lateral milk teeth are shed and are replaced by the permanent incisors, which become level with the centrals at *4 years old*. At this age a horse thus possesses four large incisor teeth and two small milk teeth in each jaw.

At 4½ years old the corner milk teeth are shed and the permanent ones appear, being well up at *5 years old* but still sharp and shell-like. Thus, at 5 years old the horse possesses a full mouth of six permanent incisor teeth in each jaw.

At *6 years old* the cup or infundibulum has usually disappeared by wear from the lower central incisors, but an enamel spot or star may persist for one or two years longer. The sharp edge has disappeared from the corner incisor, forming a table.

After 6 years old thoroughbred horses are usually called "aged," and although there are certain data which assist one in estimating the age after that period one can be much less positive on the point.

At *7 years old* the infundibulum has disappeared from the centrals and laterals, though a trace of the enamel may persist, and at this age or earlier a small projection called the *hook* can usually be observed at the posterior corner of the upper corner teeth. This is due to the fact that the lower corner incisor table does not completely oppose the table of the upper corner tooth at this time.

At *8 years old* the infundibulum has disappeared from all the lower incisor teeth, and generally the hook has become worn away from the upper corner tooth.

The upper incisor teeth, with the exception of the corners, are rarely referred to, but it may be mentioned that as a rule the upper temporary teeth are shed a little sooner than those of the lower jaw, and moreover the infundibulum is deeper and consequently persists about two years longer than in the opposing lower incisors.

The Secondary Mark, Dental Star, or Fang Hole.—As the result of the wearing away of the crown of incisor teeth, a trace of the pulp cavity sooner or later makes its appearance. This is indicated by a slight discoloration or mark a little nearer the front of the tooth than the position of the infundibulum. This is called the *star* or *secondary mark*. It generally appears in the central teeth lower jaw at *8 years old* and in the laterals at *9 years old*. It is readily distinguished from the infundibulum by the absence of enamel.

As age advances changes also take place in the shape of the tables of the incisor teeth. At first they are very much wider from side to side than from front to back. They subsequently become more or less triangular in outline—a change that is observed in the centrals at 9 years old, in the laterals at 10, and in the corner about 11 years. Later the tables become almost round, and in very old horses they are often wider from front to back than from side to side.

Galvayne's Groove.—At 9 years old a well-marked groove, called *Galvayne's groove*, begins to make its appearance close to the gum of the upper corner incisor teeth and gradually extends downwards, so that it reaches about half way down the tooth at 15 years old and extends the whole length of the tooth at about 20 years old. After this age it tends to disappear in the same direction, and is missing from the upper half of the tooth at 25 years old, still persisting in the lower half, while it disappears entirely at about 30 years old.

Intermediate ages can be estimated by the length of this groove. It should be pointed out, however, that not infrequently Galvayne's groove differs in length on the two upper corner teeth of the same horse. In such a case the average should be taken.

Other changes which occur as the result of advancing age involve the slope of the teeth and their length. In young horses the upper and lower incisors meet and form almost a semicircle, but later the teeth form a wider angle with the jaw and thus project forwards, so that in very old animals they stick almost straight out. At the same time the gums recede faster than the teeth are worn, making the teeth apparently longer. In extreme age, however, when the gums have receded to their utmost limit, the effect of wear may reduce them to comparatively short stumps.

The Canine Teeth or Tushes.—These teeth are usually only present in males, although small rudimentary tushes are present in mares. There are no temporary canine teeth in horses. The permanent tushes usually pierce the gum between 3½ and 4 years old and are fully developed at about 5 to 5½ years old, looking fresh, white and shelly, and possessing sharp edges and also grooves on the inner surfaces which can be readily felt with the finger. These edges and grooves have usually disappeared at 7 years old, and later the points become worn and the tushes discoloured. The opposing tushes do not meet as in the case of other teeth. The wear they undergo is the result of mastication, and in very old horses the tush may consequently be reduced to a comparatively short stump.

The Molar Teeth, Grinders, or Cheek Teeth.—An adult horse possesses normally six permanent molar teeth on each side of each jaw, the first three of which are preceded in the young animal by temporary molars.

The **temporary molars** are usually in position at birth or within one month after birth.

The Permanent Molars.—The first permanent molar to make its appearance is the fourth in position, which comes through at from 10 to 12 months old. Between 18 and 24 months (averaging about 1 year and 9 months) the fifth molar appears. Between 2½ and 3 years the first and second temporary molars are lost and replaced by permanent teeth. At 4 years old or thereabouts the third temporary molar is replaced by a permanent one and the sixth permanent molar appears. Occasionally a supernumerary pre-molar is present in front of the first molar. It is usually extremely small, and makes its appearance at about the age of 5 or 6 months. It is sometimes shed in the upper jaw, but usually remains permanently in the lower jaw, and is known as a wolf tooth.

The total number of teeth of the horse may thus be shown :

Temporary, on each side of each jaw—
I. 3; T. 0; M. 3=6. Total, 24.
Permanent, on each side of each jaw—
I. 3; T. 0 or 1; M. 6=9 or 10. Total, 36 or 40.

This total may be increased when wolf teeth persist.

Bishoping.—" Bishoping " is a fraudulent practice, the object of which is to make the teeth of an old horse resemble those of a younger horse. For this purpose the long incisor teeth are shortened by means of a file or saw and an artificial infundibulum is made by means of a drill or hot iron. In the former case the mark thus produced is discoloured by the application of silver nitrate. The fraud can be readily detected by the absence of the enamel ring round the infundibulum and also by the angle at which the upper and lower teeth meet.

Wolf Teeth.—The presence of the so-called wolf teeth is often thought undesirable by laymen, by whom they are said to cause " pulling," and at other times to be responsible for inappetence and loss of condition. These views are no doubt erroneous, and the practice of extracting them or removing them with a punch and mallet is unnecessary.

The Ox

Cattle possess no incisor teeth in the upper jaw. Their place is taken by a dense mucous membrane which is called the *dental pad*. In the lower jaw there are four pairs of incisor teeth or *pincers*, named respectively from the mid-point, *centrals*, *middles*, *laterals*, and *corners*. They are all simple teeth and possess no infundibulum. The crown is white and shovel- or chisel-shaped, and the root is somewhat loosely fixed, allowing considerable movement of the incisor teeth. The neck is well marked.

The **temporary incisor teeth** are distinguished from the permanent ones by their very small size. They are usually present either at birth or within three or four weeks after birth.

The **permanent incisor teeth** are erupted less regularly than those of the horse, depending mainly upon the breed and mode of feeding. The following periods may be regarded as average, though an allowance of three months in either direction may be met with not infrequently.

The central permanent incisors appear at 1 year or 9 months and are well up at *2 years old.* The middles appear at 2 years and 3 months and are level with the centrals at *2½ years old.* The laterals appear at 2 years and 9 months and are well up at *3 years old.* The corners appear at 3 years and 3 months and are well up at *3½ years old.* Owing to the irregularity already referred to, it is quite possible to meet with authentic cases of 3-year-old cattle possessing eight permanent incisor teeth. Such cases require careful investigation, and reference may be made to the third molar. If this tooth is a permanent one and is well up and meeting its opposing tooth, the animal should be regarded as fully 3 years old.

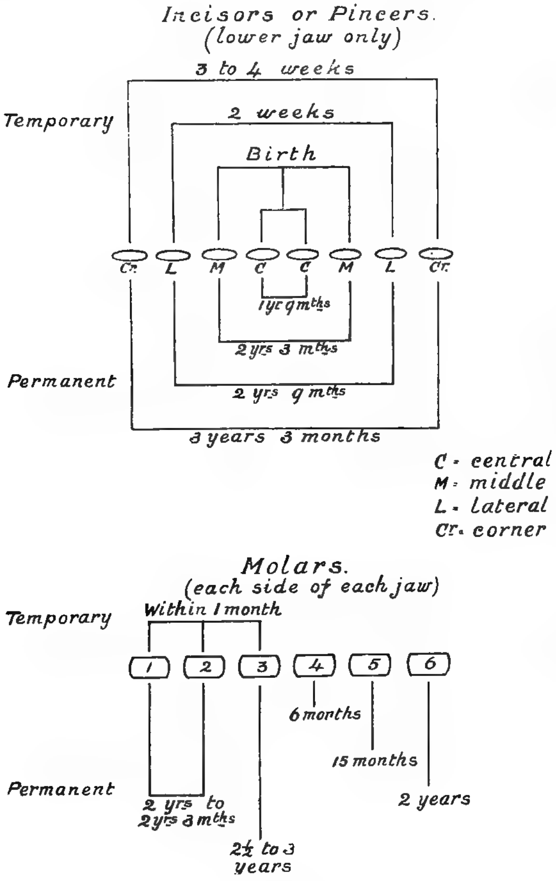

Fig. 341.

With advancing age the incisor teeth become more widely separated. The necks become more pronounced and the suggestion of a table often forms at the top of the crown.

The Molar Teeth.—The temporary molar or cheek teeth are all in position within a month after birth.

The first permanent molar to appear is the fourth, which is in position at 6 months old. The fifth molar is cut at about 1 year and 3 months. The sixth molar appears at from 2 years to 2 years and 3 months, and the first and second temporary molar teeth are shed and replaced by permanents about the same time or shortly afterwards. At about 2½ to 3 years the third temporary molar is shed and the permanent is in position.

The number of teeth possessed by cattle may be shown by the following table :

Temporary, on each side of *upper jaw*—
I. 0; M. 3=3.
Temporary, on each side of *lower jaw*—
I. 4; M. 3=7. Total, 20.
Permanent, on each side of *upper jaw*—
I. 0; M. 6=6.
Permanent, on each side of *lower jaw*—
I. 4; M. 6=10. Total, 32.

(The age of the horned breeds of cattle can frequently be estimated by the examination of their horns and the counting of the rings which appear there. The first ring usually appears at about 3 years, and subsequently an additional ring occurs every year. The calculation, therefore, consists of counting two years for the tip and one year for each ring present. For example, if the horn of a cow carries 4 rings the age of that animal would be estimated at 6 years old.)

The Sheep

The number and position of teeth of the sheep resemble those of cattle, but their eruption differs from them. The incisor teeth are proportionately longer and narrower than those of cattle, and the roots are more firmly fixed than in those of the ox. The molars are covered by a thin layer of cement which is usually black.

Incisor Teeth or Pincers.—The lamb has rarely any *temporary incisors* present at birth, but as a rule the centrals and middles are cut before it is a week old. The third pair or laterals are usually through within a fortnight, while the corner incisors are present at about 1 month old.

Permanent Incisors.—As in the ox, there are greater variations in the eruption of these teeth than in the horse. The average periods, however, may be taken as follows :

The central permanent incisors appear at about 1 year and 3 months, and the other incisors follow at intervals of about 6 months ; consequently the middles appear at 1 year and 9 months, the laterals 2 years and 3 months, and the corners at about 2 years and 9 months or 3 years.

A 2-toothed sheep (implying 2 permanent incisors through and well up) is about 18 months old.

A 4-toothed sheep (implying 4 permanent incisors through and well up) is about 2 years old.

A 6-toothed sheep (implying 6 permanent incisors through and well up) is about 2½ years old.

An 8-toothed sheep or "full-mouthed" sheep is about 3 years old.

After that age the teeth become discoloured and often broken, and sheep are then called "broken-mouthed."

The Molars.—The temporary molars are all present in from 2 to 4 weeks after birth. At 3 months old the first permanent molar, the fourth in position, appears, though it may be delayed one or two months in the upper jaw. At about 9 to 12 months old the fifth permanent molar appears. At from 18 to 21 months old the sixth molar is in position, and about the same time or shortly afterwards the first three temporary molars are replaced by permanent molars.

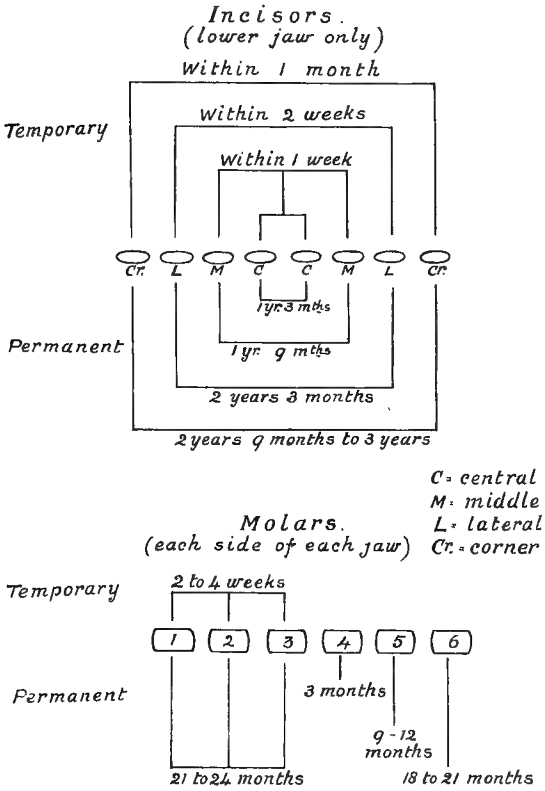

FIG. 342.

The Pig

The dentition of the pig differs considerably from that of the animals already referred to.

The Incisor Teeth. Temporary.—The pig possesses three pairs of incisor teeth, named respectively, centrals, laterals, and corners, the permanent ones being preceded by temporary or milk-teeth. There is also a temporary tush. At birth the temporary corner incisor and temporary tush are both in position. The central incisor appears at about 3 to 4 weeks and the lateral incisor appears at about 2 months after birth.

The **permanent incisors and tushes** are erupted in the same order as the temporary teeth. The corner incisors and tushes appear at about 9 months old, the central permanents at about 12 months old, and the lateral permanent incisors at about 18 months old.

The Cheek Teeth or Grinders.—The second and third temporary molars appear in the upper jaw within a week after birth. In the lower jaw they are often delayed until the pig is from 2 to 4 weeks old. The first temporary molar is present at about a month or 6 weeks old. The fourth molar, which is the first permanent grinder to show, appears at 5 months old, and is followed very shortly by the premolar teeth in front of the temporary molars at between 5 and 6 months old. The fifth molar appears at about 10 months. The temporary molars are replaced more or less together between the ages of 12 and 15 months. The last tooth to appear is the sixth molar, which comes through at between 18 and 20 months old.

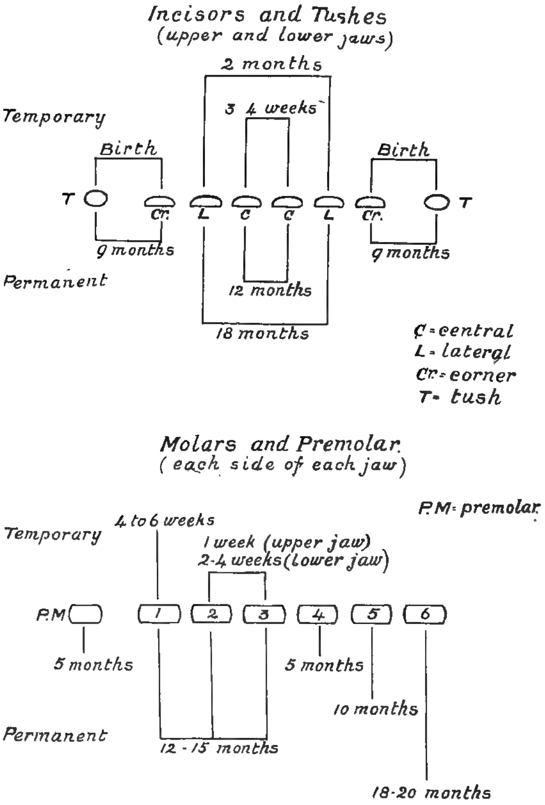

FIG. 343.

The number and position of the teeth may be seen from the following table :

Temporary, each side of each jaw—
I. 3; T. 1; M. 3=7. Total, 28.
Permanent, each side of each jaw—
I. 3; T. 1; P.M. 1; M. 6=11. Total, 44.

The Dog

The dog possesses 28 temporary teeth and 42 or 44 permanent teeth.

The Temporary Teeth.—None of the temporary teeth of the dog are present at birth. The temporary canine is usually the first to appear at between 3 and 4 weeks old, and this is quickly followed by all the other temporary teeth, which are present between 4 and 5 weeks old, consisting of central, lateral, and corner incisors, and first, second, and third molars. The molars may precede the incisors by several days or a week.

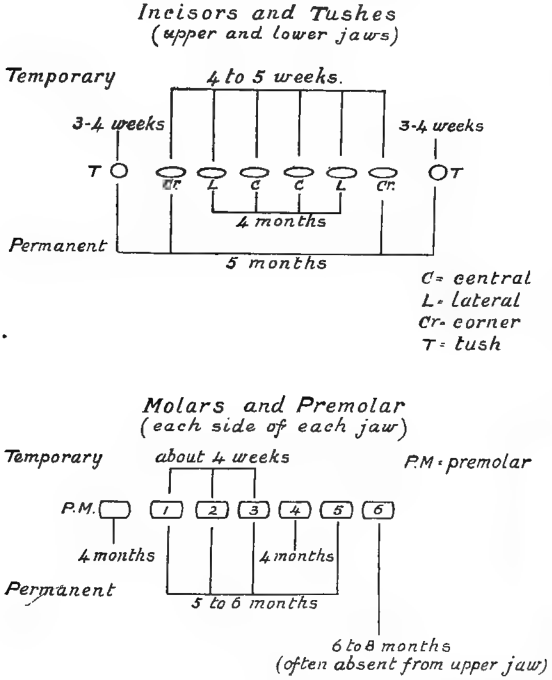

Fig. 344.

The Permanent Teeth.—The first permanent teeth to appear are the central and lateral incisors, which come through about 4 months old—a little variation may be met with in either direction. The permanent corner and tush appear at about 5 months old.

Of the **cheek teeth** the pre-molars, which are permanent at the outset, appear at about 4 months old, and the fourth molar between 4 and 5 months. Between the age of 5 and 6 months the fifth molar appears, and the first, second, and third temporary molars are replaced by permanent ones. The sixth molar appears at from 6 to 8 months old in the lower jaw and is often missing from the upper jaw.

The third upper molar and the fourth lower molar are larger than the others and are called the " carnassial " teeth.

Temporary, each side of each jaw—
I. 3; T. 1; M. 3=7. Total, 28.
Permanent, each side of each jaw—
I. 3; T. 1; P.M. 1; M. 6=11. Total, 44.

There is frequently one molar less in each side of the upper jaw, reducing the total to 42.

G. H. W.

SURGICAL SHOEING

Surgical shoeing is usually carried out by a competent horse-shoer working in conjunction with a veterinary surgeon.

The veterinary surgeon, being scientifically trained in anatomy, physiology, and conformation of the horse, can explain to the shoeing-smith the parts of the diseased foot capable of bearing weight, and the parts to be protected.

Surgical shoeing may be utilized to remove or reduce defects in the limbs due to faulty conformation ; to prevent injuries ; and to remove the causes of many forms of lameness. By applying a shoe so as to modify the distribution of the body-weight on a foot, or by protecting injured portions of the foot, horses which would otherwise be useless are rendered workable.

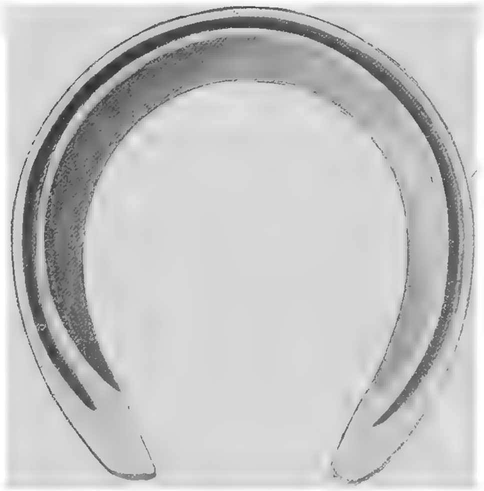

Fig. 345.

Stumbling.—Stumbling, a defect in horses, is usually due to fatigue, over-driving, staleness, etc., but is sometimes also due to neglected or bad shoeing.

Stumblers from whatever cause are improved by shortening the toe of the front feet and applying a shoe with a rolled toe.

A most useful shoe of this type is the Fitzwygram shoe (Fig. 346). This is a concave shoe. The bearing or hoof surface is flat. The branches of the shoe narrow towards the heels. At the toe the shoe is thinned and rolled upwards, this rolling forming more or less of a broad clip. The ground surface of a newly-applied Fitzwygram shoe has the appearance of an ordinary shoe three parts worn.

Owing to the difference in the width of the web between the toe and heel and the dishing out of the ground surface, this shoe is difficult to make. The principal advantage of the shoe is the upturned rolled toe, and this toe may be made on ordinary shoes. An ordinary shoe with a Fitzwygram pattern of toe is most effective in reducing the liability to stumble in stale and worn horses, and it also increases the wearing life of the shoe.

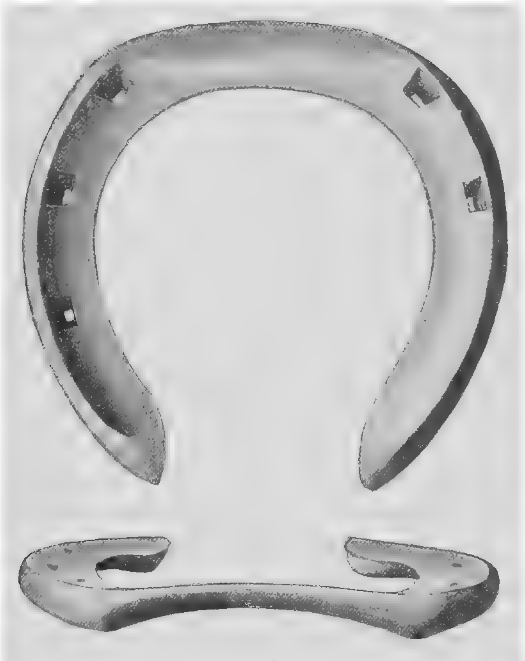

Fig. 346.

Forging or Clicking.—When the toe of the hind shoe strikes the ground surface of the fore shoe and causes the noise so much disliked by horsemen it is called forging. Forging may be due to bad conformation, fatigue, overgrown feet, or neglected shoeing. When a horse forges the hind foot is approaching the end of its flight before the fore foot has left the ground. To prevent this the horse should be shod so that the action of lifting the fore foot from the ground is quickened and that of the hind foot is delayed.

Slight cases of forging can be improved by reducing the toe of the front foot and applying a closely-fitting concave shoe with a rolled toe and bevelled heels. If the horse continues to forge, the toe of the front foot should be reduced as low as possible and the heels spared. It may even be necessary to apply calks to the front shoe. The posterior face of the calks should be bevelled downwards and forwards. The raising of the heels facilitates the quick picking up of the fore feet. In shoeing the hind foot of horses that forge the forward action is delayed by sparing the toe and reducing the heels. The shoe should be flat with square toe and quarter clips. The ground surface of the shoe should be well rounded at the toe. In fitting, the shoe should be set back at the toe so that the wall protrudes beyond the shoe at that point. The longer the heels of the hind shoe the more readily the foot is put down, as the heels of the shoe trail on the ground just before the foot alights. Another form of hind shoe which is successfully used to prevent forging is the diamond-toed shoe (Fig. 347). The ground surface of this shoe is bevelled downwards and backwards at either side of the toe. The depth of this shoe at the heels is about $\frac{1}{8}$ inch less than at the quarters. Two quarter clips are drawn.

The square-toed and diamond-toed shoes are a great disadvantage in some cases, especially in sickle-hocked or curby horses; owing to the reduction of the heels there is too great a pitch thrown on the foot axis, thus causing a great strain of the posterior part of the hock joint and the flexor tendons.

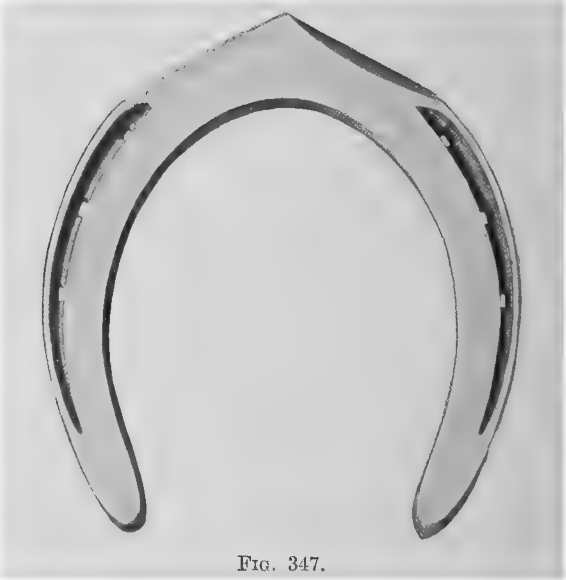

Fig. 347.

Over-reach.—This is the name given to an injury produced at the heel of the fore foot by the shoe of the hind foot. Occasionally over-reaches occur above the fetlock at the back of the fore leg. The injury may vary in degree from a slight bruise to a severe wound involving the subcutaneous tissues. When the skin is broken there is usually an underlip of skin hanging downwards.

Over-reaches usually occur at a gallop, but are sometimes seen in fast trotters.

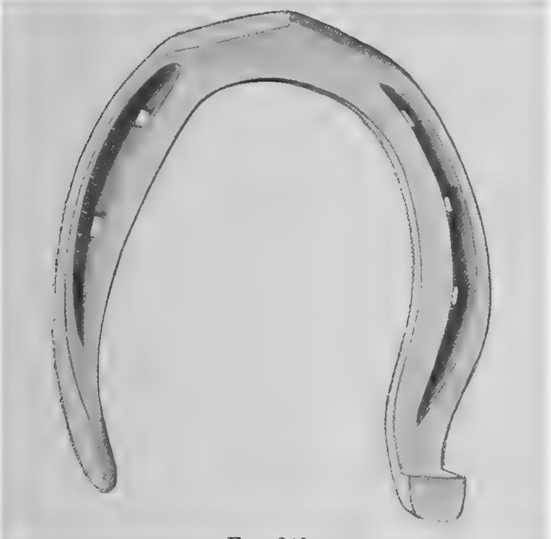

Fig. 348.

Horses liable to over-reach should be shod with concave hind shoes. The borders of the hind shoe should be well rounded at the toe. The hind shoe should be so fitted to the foot that the wall at the toe protrudes over the shoe.

Brushing ; Cutting ; Interfering.—A horse brushes or interferes when the hoof or shoe in motion strikes the opposite leg, usually the fetlock. The injury caused varies in degree from soiling of the hair to deep wounds.

In the case of the fore limbs, when the foot in flight strikes the opposite leg at the knee it is known as speedy cutting. Interfering may be due to bad conformation, weakness, indifferent shoeing, or overgrown feet.

To prevent interfering it is important to pay particular attention to the conformation of the limbs, style of gait, and to detect the part which inflicts the injury. In addition the nature of the work performed by the horse must be taken into consideration. No definite pattern can be laid down as an all-round anti-brushing shoe, because the horse may strike the opposite leg with the toe, quarter, or heel.

Brushing is commonly seen in horses in which the inner half of the hoof or shoe is lower than the outer, this causing the fetlock to be bent inwards and getting in the line of flight of the opposite foot. In such cases you prepare and shoe the hoof of the injured leg by giving the hoof a level bearing and applying a shoe whose inner branch has a greater depth than the outer. The fetlock then assumes a more upright position. As this form of brushing is usually bilateral, it is better to apply a " knocked-up " shoe to each hind foot. This shoe has four to five nails on the outer branch and two nails on the inner branch near the toe (Fig. 349). The shoe has a clip at the toe and outside quarter. The inner branch is again knocked up so that its height is at least one-eighth higher than the outer branch. The outside border of the inner branch is chamfered downwards and inwards. The hoof surface is horizontal while the ground surface may be flat or fullered. A small calkin on the outside heel, especially in carriage and riding horses, is an aid to prevent slipping. Care should be taken in fitting the outer branch. It should follow closely the direction of the wall. The outer branch of the shoe should be kept short, as a long heel tends to thrust the fetlock inwards.

For horses which strike the opposite limb with the inside toe of the shoe, it is necessary to apply a shoe with the inner branch straight from the toe to the inner quarter. The shoe is devoid of nail-holes at this part. The shoe is fitted full at the quarter and inside heel with two nail-holes towards the inner heel and four nail-holes in the outer branch. The shoe is clipped at the toe and outside quarter. The striking part of the shoe should be carefully rounded in a downward direction. In fitting, the hoof should project over the shoe at the striking part.

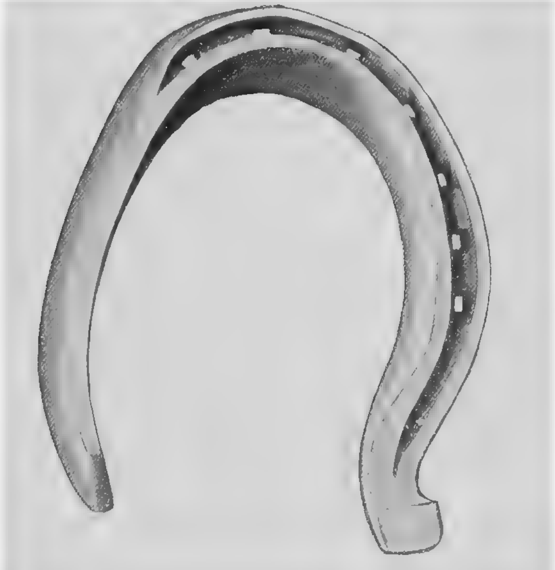

Fig. 349.

To those horses which strike with the quarter and heel it is most difficult to apply anti-brushing shoes successfully. The most useful form of shoe is a feather-edged, the inner branch is devoid of nail-holes, with two nail-holes at the toe and three or four in the outer branch (Fig. 350). The feather-edged inner branch of the shoe has its outside border chamfered downwards and inwards; the lower edge is rounded off. This shoe has a clip at the outside quarter towards the toe and a small clip at the inner quarter towards the heel. In fitting, the latter clip is fitted hot and let into the wall so that it is flush with the wall, leaving no projecting edges. Generally speaking, the lighter anti-brushing shoes are the better. The heavier the shoe the more the tendency for the horse to get tired.

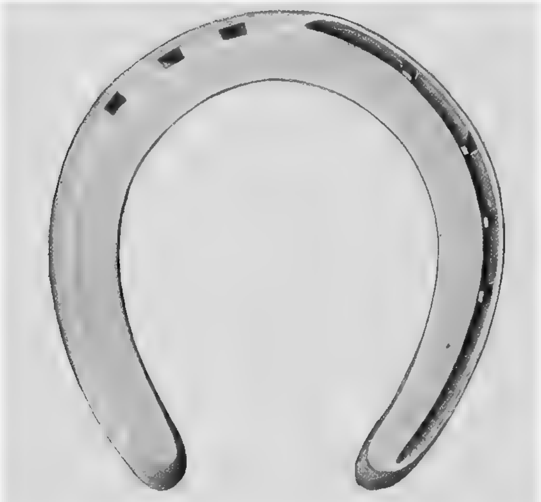
Fig. 350.

Shoes weighted on the outer branch tend to abduct the limbs during flight and so prevent brushing, but being difficult to make and apply they have never found much favour.

Knuckling.—Knuckling over is usually due to a contraction of the posterior or flexor tendons, or to a bony growth (ringbone) which inhibits the free normal movement of the fetlock, pastern or coronary joint. It is occasionally seen in horses affected with spavin.

Owing to the peculiar action there is a great amount of wear of the horn at the toe. The hoof assumes a stumpy and upright appearance. For this condition a shoe with a beak or projecting toe piece is the most suitable. The beak acts as a strong point of leverage and at the same time forms a good protection for the horn at the toe (Fig. 351).

By using a pointed beak the horse may injure himself, and if the toe is dragged the shoe is likely to be torn off. The beak should be curled upwards forming a ring, or it may be curled upwards and backwards toward the wall of the foot. The extremity is spread out disc-shaped and rests against the horn wall. By this means the liability of the shoe being torn off is decreased.

For young horses affected with contracted tendons the above form of shoe used without calkins is very useful. By its use there is a steady tension on the back tendons, which tends to elongate them.

Laminitis.—Laminitis is an inflammation of the fleshy leaves or sensitive laminæ of the foot. The front feet are more commonly affected.

In severe cases the form of the hoof becomes changed, the sole becomes flat or even dropped. If this takes place special shoeing is required to render the horse workable.

Animals affected with laminitis have a characteristic gait. In moving the heel comes to the ground first, consequently the greatest wear of the shoe takes place at the heels.

For horses affected with chronic laminitis the best shoe is a seated-out rocker-bar shoe, clipped at either side of the toe (Fig. 352). The shoe is seated-out on its bearing surface to prevent pressure on the sole. The actual part of the shoe in bearing is the same width as the wall. The shoe is thinner at the toe and heels than at the quarter, thus forming a rocker or cradle shape.

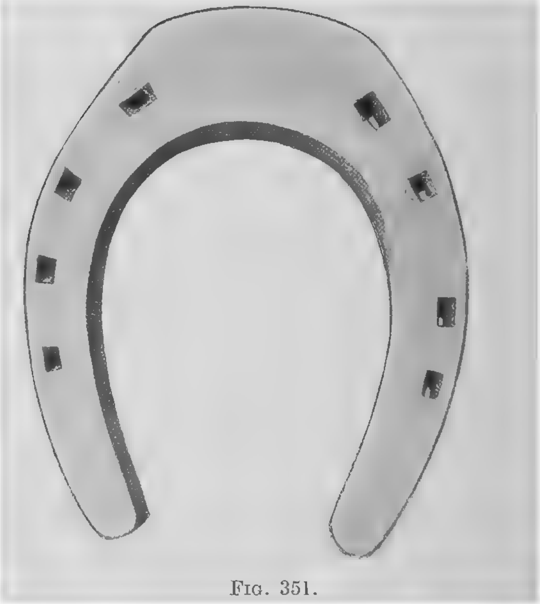
Fig. 351.

In fitting, the shoe should be very full around the toe to provide plenty of cover as protection for the most sensitive part. The sole should be relieved of all bearing. The bulbs of the frog should rest directly on the bar. The nail-holes punched in the shoe should be placed posterior to the clips. Nail-holes are not to be placed near the toe. In some chronic cases of laminitis there is a tendency for the shoe to be displaced forwards. This is best prevented by turning up a broad clip at the posterior edge of the bar to embrace the bulbs of the heel.

Contraction of the Hoof.—In contracted feet the hoof becomes narrow at its posterior part. The buttresses press on the frog, which becomes atrophied. The contraction may affect one-half of the foot, but is usually bilateral. Contraction is more common in fore than hind feet.

Paring of the bars, sole, and frog, or the rasping of the periople or outer layer of the wall, which induces drying of the horn, all favour contraction.

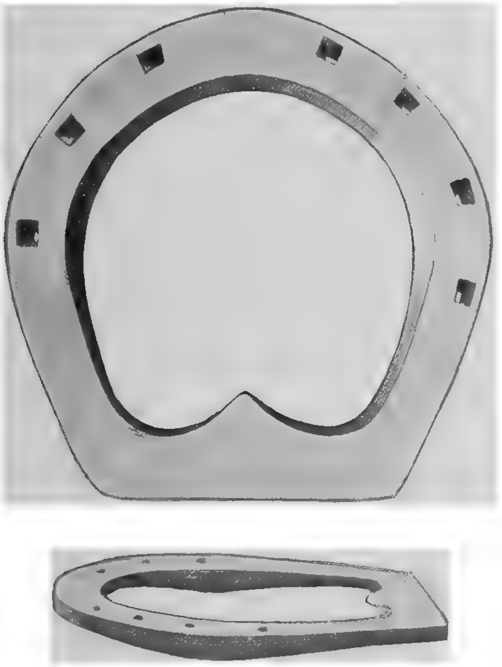

Fig. 352.

The first aim in the treatment of contracted feet is to endeavour to restore as far as possible the frog and plantar cushion to their full-grown normal size. This object is best obtained by shoeing the foot so that the frog and posterior part of the foot participate to a large extent in taking the weight; by the use of tips or half shoes which protect the bearing surface of the anterior half of the foot, but allow the frog and posterior parts of the foot to come in direct contact with the ground. By this method there is no restraint due to the shoeing on expansion taking place in the posterior part of the foot. This favours development of the frog, plantar cushion, and free natural movement of the lateral cartilages.

The tip may be made from an ordinary shoe by cutting off sufficient from the end of each branch, and the foot prepared so that the tip is let in flush with the bearing surface of the horn posterior to it to give the foot a level bearing, but tips thinned out gradually to the ends of the branches are as effective and easier to apply.

If the horse is being treated for contracted feet or working on paved streets it may be necessary to protect the posterior part of the foot from too rapid wear, but at the same time distributing weight over that part. Under these conditions rubber bar pads with leather soles in conjunction with tips are most useful.

Various forms of shoes with mechanical devices to reduce or remove contraction of the hoof have been introduced from time to time.

The prevailing principle of these shoes is a hinge at the toe, clips on the inner border of the shoe at the heels, and a spring or screw between the heels of the shoe to force them apart. These mechanical devices have never gained much favour. They are difficult and expensive to make, require constant adjusting, and are of doubtful value.

Sandcrack.—A sandcrack is a split in the horn of the wall, commencing at the coronet and running downwards. The crack may be at the toe, quarter, or heel. As the bulk of the horn of the wall is produced by the coronary band, anything which weakens the horn-producing part of this band favours the formation of a crack, *e.g.* any injury to the band or undue strain thrown on any one part through unequal tread caused by bad preparation of the foot or uneven shoes. Sandcrack is also frequently seen in dry brittle hoofs.

The crack may be on the surface or may extend as deep as the sensitive laminæ.

When shoeing for sandcrack one must aim at reducing or removing all movement at the edges of the crack. Remove pressure of the shoe opposite the part, and distribute the weight so that the frog and posterior parts are brought into direct bearing.

For all forms of sandcrack, whether at toe, quarter, or heel, the hoof should be so prepared as to give a level bearing. The axis of the foot when viewed from the side should be straight. For sandcrack at the toe a bar shoe should be applied so as to get the full benefit of frog pressure. Thus the heels tend to spread and the toe to become narrow and thus bring the edges of the crack together (Fig. 353).

The shoe should be clipped at either side of the toe, and the shoe "set out" for 1 inch to $1\frac{1}{2}$ inches opposite so that there is no direct bearing on that part. Nail-holes should never be driven at or near the sandcrack.

The disadvantages of a bar shoe are many. They are difficult to make and fix. They are heavier than the ordinary shoe, require more nails to secure to the foot, and are more liable to be torn off.

By using an ordinary shoe with a rubber bar pad one gets the advantages of the bar shoe without the difficulty of making and fitting and without the increased weight. For sandcrack at the quarter a bar shoe is also applied with one clip at the toe. No nails should be driven near the crack and the shoe should be "set out" for a space corresponding to the base of a triangle, one of whose sides is formed by a split in the hoof and the other side by a perpendicular line dropped from the highest point of the crack at the coronet. Having applied the shoe the edges of the crack should be further immobilized by clips placed across the crack. Further, a tarred bandage should be wound around the hoof to prevent grit entering the crack.

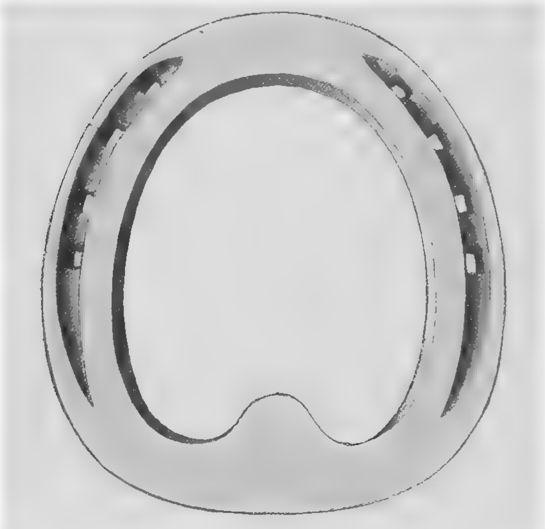
FIG. 353.

Corns.—A corn is a bruise to the sensitive sole at the posterior part of the foot in the angle formed by the bar and the wall. Corns are in most cases due to pressure by the heel of the shoe on the seat of injury, this being due to indifferent shoeing or allowing the shoes to remain on too long before removing.

In shoeing horses with corn it is necessary first of all properly to prepare the foot; if the toe is overgrown it must be shortened to get a proper level bearing. Apply a shoe in which the wall opposite the corn is relieved of pressure.

If the corn is dry and not severe a three-quarter shoe may be used. This shoe is made by cutting 1 inch to 1½ inches off the heel (usually the inner) of an ordinary shoe. The end of the shortened heel should be bevelled downwards and forwards (Fig. 354). This shoe is simple to make and easily fitted to the foot. It, however, reduces the area for the distribution of the body-weight and has the further disadvantage of leaving the seat of corn exposed and liable to injury from loose stones or uneven surfaces on the roads.

By the use of a bar shoe (one with a transverse bar between the heels) the frog is brought into bearing and takes a proportion of the body weight. This develops the frog and decreases any tendency to contraction at the heel. The wall opposite the corn may be relieved of pressure by "setting out" the shoe at this part. The bar shoe is made of a longer length of iron than an ordinary shoe. In making the shoe the extra length of iron forms a prolongation of the heels. The shoe is shaped and fitted to the foot as for an ordinary shoe, and then the extra length at each heel is turned at right angles towards each centre, where the ends are welded. The web and thickness of iron in the bar should equal that of the branches of the shoe. The posterior edge or border of the bar should be bevelled downwards and forwards. Except in special cases the bar should have a horizontal foot surface and should take its bearings on the bulbs of the frog. In some cases, such as a contracted foot with suppurating corn, it is necessary to use a bar shoe with the inner heel removed. This is known as a three-quarter bar shoe. The inner heel is removed as in a three-quarter shoe (Fig. 355). With this shoe one has the advantage of being able to apply local dressings to the affected area without removing the shoe. The free end of the bar and the free end of the inside branch of the shoe should be sloped off, this reducing the liability of the shoe being thrown off.

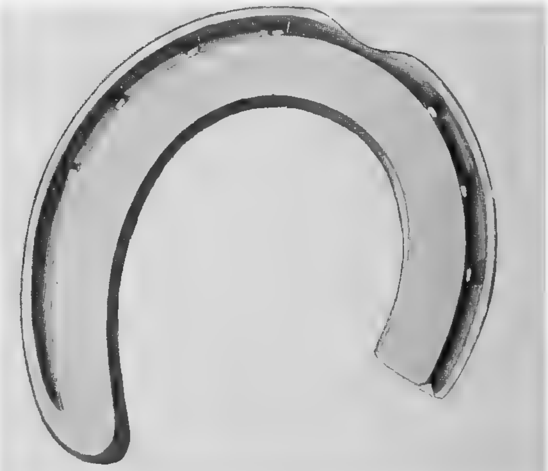
FIG. 354.

In a case of double suppurating corn on one foot a tip with a frog-bearing plate is applied. This is known as an anchor shoe. The toe and frog take all the weight, the affected parts are kept free of contact with the ground. This shoe is only used on horses being treated and kept in the stable. It is apt to be torn off during movement.

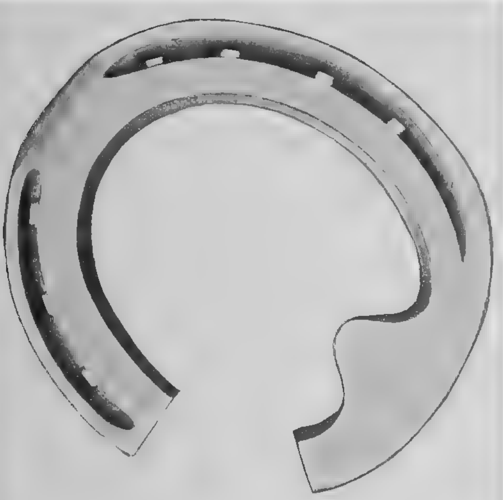

FIG. 355.

Sprained Tendons.—Sprain of the flexor tendons at the back of the leg below the knee and hock joints is not uncommon in the horse.

In the acute stage when there is severe lameness the animal is greatly relieved by raising the hind part of the foot, which removes a certain amount of tension on the tendons.

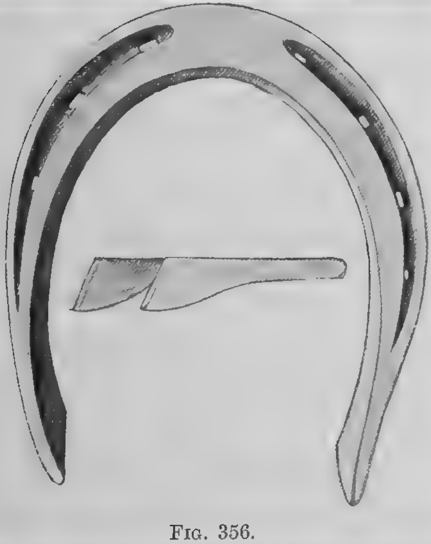

FIG. 356.

The most suitable shoe for this purpose is one that has both heels "knocked up"—a wedge-heeled shoe (Fig. 356). The height of the heel varies according to the degree of severity of the case. It varies from 1 to $1\frac{3}{4}$ inches. The shoe has two quarter clips and six-nail-holes. When fitted to the foot the whole of the under surface of the shoe should touch the ground. Prolonged use of this form of shoe for strained tendons induces chronic contraction; when the inflammation has subsided a flat shoe should be applied.

A wedge-heeled shoe for strained tendons is much superior to one with calkins of the same height of heel, because the latter are more liable to sink into the ground, thus neutralizing the height effect, and the distribution of weight is not so even as it is with the wedge-heeled shoe, which has the whole of the ground surface in contact.

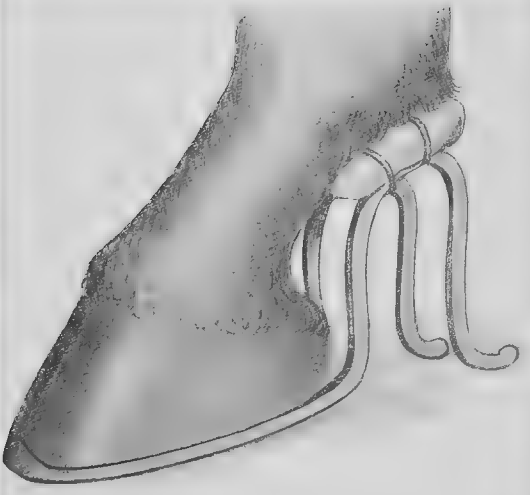

FIG. 357.

Wedge-heeled shoes are similarly useful in the early treatment of curb.

For partially ruptured tendons Patten or Crutch shoes are used. They are only used on animals being rested and treated in the stable. The patten is like an inverted staple. It is attached to the heels of the shoe to increase the height. The patten may be 2, 3, or even 4 inches high. The shoe is first fitted to the foot and the patten is then welded on at such an angle that the under border of the patten rests level on the ground when the shoe is nailed on. The web of the patten should equal the web of the shoe. The patten may be made detachable by tapping and screwing a hole in each heel of the shoe, and attaching the patten with small bolts. By this method pattens of varying heights may be applied without removing the shoe as the case progresses.

For those animals in which there is a complete rupture of the tendons and the posterior point of the fetlock descends almost to the ground a shoe with a swan neck support is necessary. The shoe with prolonged heels is first fitted to the foot and the support either welded or screwed on afterwards. The support is really a continuation of the heels of the shoe upwards to the height of a point of the fetlock in its normal position. It is then bent at right angles backward for about 2 inches, where it forms a platform on which the fetlock rests. The branches are then continued downwards and backwards and the ends joined by a transverse bar (Fig. 357). The top of the arch on which the fetlock rests is usually padded to prevent chafing. This shoe and support is only used on an animal kept tied up in slings during treatment. It is an advantage to have the support detachable as it may be easily removed and its height varied according to requirements.

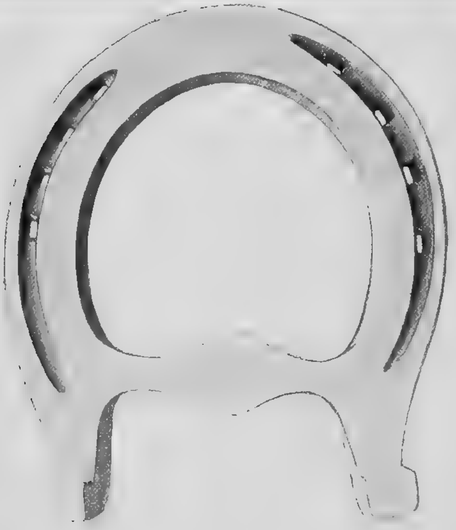

Fig. 358.

Seedy Toe.—In this condition there is a separation of the middle layer of the horn of the wall from the underlying layer. It is due to some defect in the horn-producing layer of the sensitive laminæ or leaves.

If the disease is not extensive a bar shoe may be employed, the diseased region relieved of all pressure, and the affected area treated antiseptically.

In the more severe forms where the disease extends upwards towards the coronary band it is necessary for successful treatment to have the whole of the loose wall covering the affected area removed. A bar shoe with a false wall which is like a huge clip covering the whole diseased portion is used. The false wall or clip is made of sheet iron $\frac{1}{8}$-inch thick and welded on to the shoe. It is notched at intervals of an inch to facilitate the shaping of it to the outline of the foot. It is fitted hot. If there is sufficient bearing surface to carry the shoe the horse may be worked (Fig. 358).

Rubber Pads.—The modern road, which is hard, crowned, and in many cases very slippery, has stimulated the invention of many anti-slipping and anti-concussion devices for horses' feet.

Many different forms of horse-shoe pads have been introduced, made of various materials such as rope, oakum, leather, rubber, canvas, cork, felt, wood, etc.

The most practical pads are made of rubber. The rubber pads most commonly used are of the bar type—a leather sole, to which is attached a rubber pad, is used in conjunction with a short shoe. With this pad the sole of the foot is covered, the leather lies between the shoe and the foot.

A most useful pad is Gray's Bridge bar pad. This pad is composed of a thin steel plate to which is attached a bar of rubber. The pad is placed between the heels of the shoe and forms a bar. By its use one gets all the advantages of a bar shoe, and it has the further advantage of being lighter, prevents slipping, and reduces concussion.

When applying rubber pads they should never protrude beyond the ground surface of the shoe. They should be of such a thickness as to strike the ground at the same time as the shoe. Rubber alone is not an effective anti-slipping material, but the combination of rubber and iron is most successful.

Rubber pads are most useful in surgical shoeing. They may be used in the treatment of corns, flat or dropped soles, weak heels, seedy toe, and sandcrack. Pads should not be used on horses affected with lameness due to sidebones, or in cases of canker of the frog.

B. de V.

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